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by

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MOHAMED BABIKER IBRAHIM

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بسم الله الرحمن الرحيم

In the name of Allah, the Beneficent, the Merciful

Dedication

This thesis is dedicated to my parents Hag Babiker, and Haga Al Risala my wife Arwa, and my sons Moatz and Mazin.

Abstract

This study investigates adjustment to drought hazard by the peasant farmers, pastoral nomads and government officials in the semi-arid areas of the Sudan. Through use of questionnaires 444 peasant farmers, 208 pastoral nomads and 50 government officials were interviewed in East Kordofan and East Darfur regions.

First, the history of drought in the Sudan is investigated, together with the impact of drought on human and physical environment. The study shows that drought is a recurrent phenomenon in the semi-arid areas of the Sudan, and that the current drought has had a devastating effect on crop yields, animal resources, dairy production; it has increased grain prices and forced the people of the semi-arid areas to move southward and to agricultural schemes to avoid the effect of drought. Drought followed by desertification has had an adverse effect on the natural resources of the region. Bare soils were exposed to wind. Surface and subsurface water sources have dried up, groundwater tables have fallen to a serious levels and consequently trees have died.

Second, the study investigated the inhabitants' perception, awareness and their experience with drought. A significant difference was found between the farmers and the nomads with regard to their perception of drought. While the farmers perceived drought as a lack of rainfall the nomads perceived it as a lack of grass. All farmers, nomads and government officials perceived the intensity of drought to have increased. The three groups are also well aware of drought and rated it the most serious of all problems. During recent years the people of the semi-arid areas have had an intensive experience with drought. Furthermore, the farmers and the nomads have recognized some signs of drought based on the changes of the natural environments.

The farmers and nomads of the semi-arid areas of the Sudan have consequently developed certain methods of adjustment to cope with the drought hazard. Most of these adjustments are strategies that have been developed through a long period of trial and error in which they have been modified, reframed, reconceptualized and adopted as methods of adjustment to the presistent current drought. It is these adjustments that form the major focus of this dissertation. Farmers have adopted on-farm adjustments in order to maximize moisture utilization and minimize moisture waste. These adjustments include: cultivation of quick-maturing crops; mixing of crops; intercropping; replanting; weeding; changing of farm location, and farm fragmentation. Seeds dressings also were adopted to reduce different farm hazards. Off-farm adjustments were mainly confined to migration in order to work in agricultural schemes, towns or nearby villages.

The most important adjustment adopted by the nomads was found to be migration to the southern more humid areas. During the current drought they have extended their migration by about 150 km south to areas where grass and water are plentiful, however, this is a hostile environment for their animals. Both farmers and nomads were found to diversify their adjustments. The farmers keep animals and some nomads cultivate crops.

Some differences were observed between resource users (farmers and nomads) and policy makers (government officials) with regard to perception of drought and perception of adjustment. While farmers and nomads perceived drought as a lack of rainfall and grass, the policy-makers perceived it as a decline of crop and animal productivity. Differences were also observed between resource users and policy makers with regard to perception of adjustment. While the resource users' perception of adjustment tended to be more traditional, the policy makers' perception of adjustment is viewed as a scientific plan aimed at striking a balance between utilization of natural resources and ecological conservation.

The study has practical as well as theoretical implications. The practical implications of the study are, first, despite the increase in the population of the semi-arid areas and continuous environmental deterioration, the inhabitants of these areas were able to adjust consistently and steadily to these changes. Second, when the environmental changes were extreme (like the current drought) the people were, in turn, aggressive in making adjustments. Third, the role of policy-makers in response to drought hazard is confined to emergency relief aid.

The theoretical implications of the study are, first, people's adjustment to drought is based on awareness and accurate perception of the drought hazard. Second, the study also revealed that there is a strong relationship between people's cognitive processes (perception, beliefs and attitudes) and adjustment to drought hazard and human spatial behaviour in a broader sense. Finally, perception and behaviour provide a more useful approach to understanding the problem of drought in Africa, than an understanding based on economics alone.

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Chapter 1

Introduction

1.1 Introduction

Sporadic drought is an accepted part of the semi-arid ecosystem, and of the local culture. Consequently, people in semi-arid areas have successfully developed strategies in order to adapt to this kind of drought. However, the current persistent drought which began in the mid to late 1960s (e.g., Hare 1984; Motha et al. 1980 and Trilsbach and Hulme 1984) and which has continued until the mid 1980s, has created many serious environmental, social and economic problems (Hare 1984; Hulme 1984; Kaplan 1984; Lamb 1983; Miller 1985; Nicholson 1983; Trilsbach and Hulme 1984) not only in the Sudan, but also in up to 24 other African countries (Derrick 1984; Griffin 1984; Kamm 1983).

In January 1985, government figures suggested that nearly three million Sudanese were affected by drought and were said to face starvation (Dobri 1985). However, very few scholarly studies have been undertaken to assess the socio-economic dimension of the problem (Ibrahim 1977, 1981; Abu Sin 1984).

The purpose of this study is to investigate methods of adjustment to drought hazard in the semi-arid areas of the Sudan. The study has both practical and academic implications. As far as the practical implications are concerned, it is a timely topic since drought and food shortage are problems for most African countries (Derrick 1984; Watson et al. 1984). By investigating methods of adjustment to drought, it is possible to increase our understanding and give planners, politicians and other decision makers insights into the problem. Theoretical justification for the study is that it is an attempt to contribute to one of the most demanding areas in hazard research development; that is, the relationship between hazard perception and adjustment. Mitchell (1984:59) has stated that

> They [hazard researchers] must now undertake the more difficult - and less glamorous - task of fleshing out the existing skeletal understanding of hazard perception principles in the context of hazard adjustment

processes. This requires that more attention be paid to the perception and adoption.

1.2 Location of research

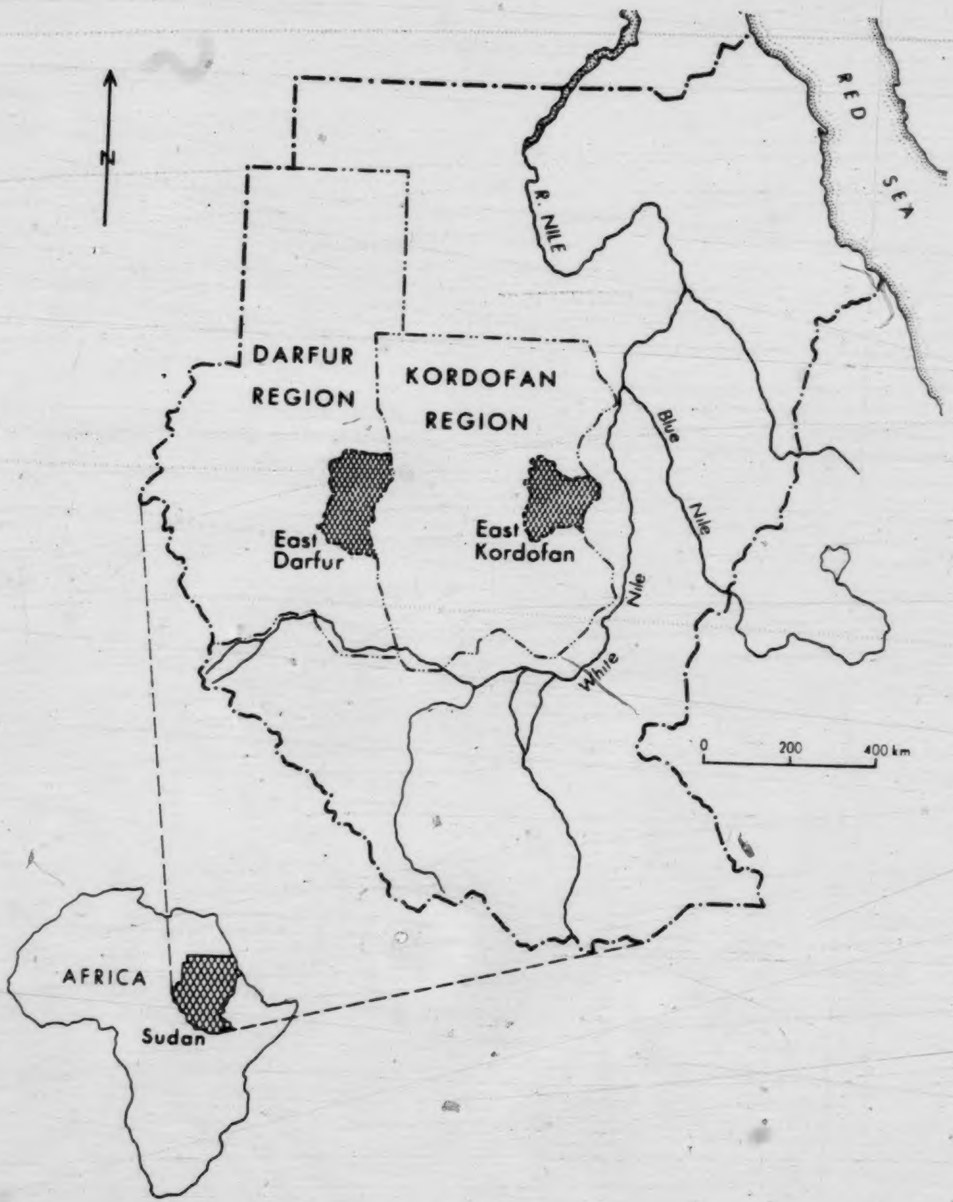
The Kordofan and Darfur regions play an important role in the economy of the Sudan (Abd Al Gaffar 1982:a; Agricultural statistics 1982; WSARP 1982). According to various studies, these regions have been adversely affected by drought (e.g., Abd Al Gaffar 1982:a; Hulme 1984; Ibrahim 1977, 1981; Tubiana and Tubiana 1977). East Kordofan and East Darfur were identified as drought areas (El Arifi et al. 1982) and were chosen for the study because they are typical of the semi-arid areas of the Sudan (Figure 1.1).

1.3 Objectives

The primary objective of this study is to investigate the methods of adjustment to drought hazard by the peasant farmers and pastoral nomads, as well as by government officials, in the semi-arid areas of Kordofan and Darfur regions of the Sudan. Little can be done to change the natural event itself, but it is believed that a great deal can be done to alter, modify or improve the human use system in order to reduce the effect of drought and its related loss potential.

The specific objectives are:

1. To investigate the differences in perception, attitudes and adjustments by farmers and nomads to drought hazard;
2. To explore the relationship between perceptions, attitudes, beliefs and adjustment of farmers and nomads to drought hazard;
3. To compare differences in the perceptions of policy-makers (government officials) and resource users (peasant farmers and pastoral nomads);
4. To provide planners and other related professionals with some insight into the adjustment to drought, in the hope that this information will help the formulation of appropriate managerial, as well as developmental plans for the whole semi-arid region.


N
R. NILE
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0
200
400 km
AFRICA
Sudan

Figure 1.1 Study areas — East Kordofan and East Darfur

1.4 Literature review

Historically, drought was assumed to be the direct cause of the decline of the Mycene and Harapan civilization in ancient Greece and North West India respectively (Bryson and Murray 1977). In recent years, the Sahelian drought (1968-73) has drawn world wide attention to the adverse effects caused by drought. Some of these effects are severe economic and human life losses (Table 1.1).

Due to the absence of accurate data, writers tend to speculate on the degree of damage caused by drought. Realistic figures are infrequently available and in some cases the estimation of damage is qualitative rather than quantitative (Table 1.1). A problem related to the estimation of damage caused by drought in terms of claiming human lives, is that drought, famine, malnutrition, and disease usually accompany each other, making it difficult to isolate the deaths which can be attributed to drought alone.

As illustrated in Table 1.1, all references cited were published in the 1970s, or after the Sahelian drought (1968-73) of west Africa. The figures of the death rate do not distinguish between the peasant farmers and the pastoral nomads. However, the one fact that remains is that drought has an adverse effect on human beings, plants, and animals.

The current African drought has become a serious problem for some 24 African countries. Hundreds of thousands have lost their lives and millions have lost their crops, animals, and homes (e.g., Derrick 1984; Dobri 1985; Iyer and Wilde 1984; Kamm 1983; Miller 1985; Watson et al. 1984). It will take a long time before the real cost of this drought can be assessed.

1.4.1 Definition of drought and desertification

A review of the literature revealed that there is no one definition that is agreed on by scholars. Writers in each field tend to define drought according to their particular interest. Therefore, meteorological, agricultural, hydrological, and urban drought were identified by different researchers. Although most scholars agree that drought involves moisture deficiency,

TABLE 1.1

Costs of Drought

Type of Loss	Country or Region .	year(s)	Extent of damage	Source
Financial	Great Plains U.S.	Annually	App. $700 million	White & Haas (1975)
	Great Britain	1976	$1,000 million	Munchener Ruck (1978)
	Chile	1967-68	$70 million	Munchener Ruck (1978)
	S.E. Australia	1967-69	$600 million	Munchener Ruck (1978)
	Tanzania	1946-65	3% of $1.1 billion	Burton, Kates & White (1978)
	Australia	Annually	$29 million	Burton, Kates & White (1978)
Human lives	Sahel	1968-73	100,000 - 250,000	U.N. (1977)
	Sahel	1968-73	100,000	Newman (1975)
	Sahel	1968-73	100,000	Gerster (1975)
	Ethiopia	1973	100,000 - 200,000	U.N. (1977)
	Ethiopia	1973	50,000 (Agri Zone)	Rivers et al (1976)
	Ethiopia	1974	100,000 - 600,000	Kohen (1979)
	Brazil	1877	Thousands (diseases)	Brooks (1973)
	Brazil	1915	60,000 (hunger & disease)	Hall (1978)
	Brazil	1970	100	Brooks (1973)
Crop failure	Sahel	1968-73	15 million villagers harvested less than 1/2 of normal yield	U.N. (1977)
	Nigeria	1968-73	Hausa cultivator lost 70% of normal harvesting	Kates et al. (1977)
	Sudan	1969-77	peasants harvested 20-30% of normal, in some Locations only 8-10%	Ibrahim (1981)
	Brazil	1969-70	Bean decreased by 78%, maize by 86% and manioc by 61%	Hall 1(1978)
Livestock	Sahel	1968-73	2 million nomads lost half of their livestock	U.N. (1977)
	Sahel	1968-73	several millions of livestock have died	Newman (1975)
	Kenya	1949	1,500,000 cattle died or slaughtered	Baker (1977)
Migration	Sahel	1973	2 million refugees in camps	Newman (1975)
	Upper Volta (some parts)	1973	Lost 80% of their inhabitants	U.N. (1977)
	Fulani (nomads)	1973	constitute 25% of one camp of refugees	Kates et al. (1977)

they disagree about the lowest volume or amount of moisture, below which drought may result.

Meteorological drought in its simplest form was defined as below or well-below average rainfall (e.g., Berry 1984; Brooks 1982; Bryson 1973; Cox 1979; Kamm 1983; Nature and Resources 1984; O'Keefe and Wisner 1975; Steila 1981). The World Meteorological Organization (WMO 1975) defined drought as a lack of sufficient water to meet the requirements of plant, animal, and human populations. Some scholars have quantified the deviation from the mean (average) by using the standard deviation (Hulme 1984; Lamb 1982; Nicholson 1983) as a method of defining meteorological drought. This approach has been used to analyse the trend of rainfall in the sub-Saharan Africa during the current drought. Another approach to quantify rainfall deficiency uses the Palmer Drought Index, which is known as Palmers' Index. Saarinen (1966) applied this method in analyzing the precipitation in the Great Plains of America. The Palmers' method relates the recorded years of precipitation to the normal amount of precipitation received in a particular region. Any recorded year with less than normal will be considered as a drought year. This method has been described as the most satisfactory and realistic in all areas (Hounam et al. 1975; Julian and Fritts 1968).

Agricultural drought has been defined as a soil moisture deficiency which harms plant growth and crop production (Barger 1949; Hounam et al. 1975; Richard 1966; Subrahmanyam 1967). Hydrological drought has been defined in relation to the deficiency or insufficiency of water in terms of surface or subsurface and ground water (Huschke et al. 1959; Krishnan 1979; Subrahmanyam 1967).

An important distinction between drought and other natural hazards and meteorological phenomena is that the beginning and ending of drought are often rather vague. Once drought starts, it tends to last for a relatively long time. (Coughlan et al. 1979; Hounam 1975; Nature and Resources 1984; White and Haas 1975).

A phenomenon which often accompanies drought in the semi-arid areas, especially in the Sudan, is "desertification." Confusion arises sometimes between the terms drought and desertification. The definition which most students of desertification agreed on at the U.N.

Conference on Desertification in 1977 (UNCOD) is that

> Desertification is the diminution or destruction of the land, and can lead ultimately to desert-like conditions (Mabbutt 1984:103).

Moreover, UNCOD identified the areas in which desertification may occur. Those areas are the arid, semi-arid, sub-humid, and productive parts of the hyper-arid climatic zones of low and variable rainfall which are inherently subject to water-stress and drought, and which are particularly vulnerable to deterioration through excessive pressure of man's use (Mabbutt 1984:104).

Indicators of desertification are overgrazing, overcultivation, deforestation, mobility of sand sheets, and waterlogging and salinization of irrigated lands. (e.g., DECARP 1976; Grove 1977; Ibrahim 1978; Johnson 1977; Rapp 1976; Warren and Maizels 1977).

To summarize, drought in a very simple sense means the lack of precipitation, while desertification means the lack of vegetation cover to such an extent that wind transports soil from bare land.

1.4.2 Studies of drought

There have been extensive studies on drought. For example, in relation to the Great Plains of North America where drought is a recurring phenomenon, Wilhite and Hoffman (1980) have cited over 4,000 references dealing with physical and human aspects of drought. Similarly, extensive drought studies have been carried out by Australian researchers, indicated by the proceedings of a 1972 Australian UNESCO Seminar (Chapman 1976). The environmental, economic and social significance of drought were discussed in a book edited by Lovett (1973). Heathcote (1969) discussed the problem of drought perception. Heathcote (1979) focussing on Australia, identified five different areas in which drought creates problems. These are: (1)the complex area of human perception of drought, (2) the significance of drought in the Australian ecosystems, (3) the impact of drought upon local, regional and national economies, (4) the significance of drought for human population carrying capacities of the continent, and (5) the political significance of drought.

The World Meteorological Organization has published some studies on drought. These studies refer to drought and agriculture (Hounam et al. 1975), and focus upon agro-meteorological aspects of drought, incidence and spread of continental drought (Subrahmanyam 1967), and a special environmental report on drought (WMO 1975).

On a regional basis, many conferences were held in Africa, especially after the famous Sahelian drought of 1969-73 in west Africa. Papers presented at these conferences were published in some books such as Dalby and Harrison Church (1973); and Dalby, Harrison Church and Bezzaz (1977). Most of these articles were general studies. Some were based on case studies, such as Oguntoyinbo and Richards (1977), who investigated the extent and intensity of the 1969-73 drought in Nigeria. In the book Drought, Famine and Population Movements in Africa (Newman, 1975), many authors highlight some of the socio-economic, climatic, and environmental aspects of drought in Africa. In Politics of Natural Disaster (Glantz, 1976), many articles referred to the Sahelian disaster of the early 1970s. Both social and natural scientists contributed to this volume. On a local basis, Apeldoorn (1981) wrote about perspectives on drought and famine in Nigeria. In addition, he reported drought and famine experiences, and the political economy of famine. He emphasized the role of pre-disaster planning for preventing future calamities.

Among the countries of E. Africa, Ethiopia is the most affected by drought. In Ethiopia, drought and famine killed two hundred thousand people in the early 1970s (e.g., Hussein 1976; Kloos 1982; Koehn 1979). Ethiopia continues to suffer greatly, and currently it has become the most publicized country in Africa because of the 1984 and 1985 droughts (Iyer and Wilde 1984; McKay 1984; Watson et al. 1984).

Somalia, Kenya, and Tanzania were equally affected by drought. Campbell (1984), Wisner (1976), and Wisner and Mbithi (1974) studied the problem of drought in Kenya. Campbell (1984) investigated the response to drought among farmers and herders, and concluded that land-use planning, a reallocation of the available land and water resources, and the promotion of off-farm employment are required to reduce the vulnerability of the population to future drought conditions. Berry et al. (1971) and Hankins (1974) investigated adjustment to agricultural drought in Tanzania.

Drought also affected the southern part of Africa. In this area, studies of drought were featured at the symposium on drought in Botswana (Hinchey 1978). Natural and social scientists contributed to this symposium, which was concerned with the planning for, and the response to, drought.

Other areas affected by drought outside Africa include Northwest India (Bryson and Murry 1977) and N.E. Brazil (Brooks 1973, 1982; Hall 1978).

1.4.3 Causes of drought

Causes of drought and climate change have been attributed to both natural and human factors. Researchers advocate that fluctuation and change in atmospheric and oceanic temperature have resulted in drought in many areas of the globe (e.g., Bryson 1973; Lamb 1974). Such atmospheric and oceanic changes were attributed to the increase of carbon dioxide (CO_2) in the atmosphere (Bryson 1973, Manabe and Wetherald 1967), or the increase of both dust and volcanic dust in the air (Bryson and Murray 1977; Lamb 1970; Rapp 1974). An increase of gases such as CO_2 in the atmosphere produces what is called the "green house" effect. In a greenhouse, sun energy comes in through the windows. When it strikes the surfaces inside, it warms them. The wavelength of the radiation is changed - "light," you might say, is changed to "heat". The greenhouse windows pass light more readily than heat. Some of the energy that enters is trapped, and the greenhouse gets warm (Bryson and Murray 1977:144). The decrease of surface temperature also is attributed to the high albedo reflectivity of solar radiation from the ground (Otterman 1974). Below-normal sea surface temperatures in the Atlantic Ocean at the same latitudes as the Sahel region, could be responsible for the Sahelian drought (WMO 1975), while changes in the hydrological cycle also may have resulted in climatic change (Lamb 1974).

Bryson and Murray (1977) stated that if differences in temperature increased equator-to-pole, or if air near the ground is heated, or the air at high altitudes cooled, the Westerlies tend to expand. The expansion of the Westerlies will push back the wet monsoonal wind and the Sahel will receive no rain.

Another factor which may have caused drought is a reduction in soil moisture. This has been explained in the following way: When the surface of the land becomes dried, there is less evapotranspiration, and less moisture available for precipitation. Furthermore, it is stated that poor land use practices (the removal of the vegetation cover) have led to a deterioration of local and surface microclimates in the arid and semi-arid zones. It is concluded that drought feeds on poor land use, and is thereby worsened (Nature and Resources 1984).

In conclusion, many natural and human factors seem to be responsible for drought. The natural factors include: changes in the horizontal and vertical temperature of the earth, expansion of the Westerlies, the increase of dust in the atmosphere and the reduction of soil moisture. On the other hand, poor land use practices which may result in the removal of vegetation cover are believed to have changed local climates and microclimates.

1.4.4 Drought within the context of natural hazards:

Kates (1970) in his general model of human response to natural hazards, stated that natural hazards are a product of the interaction of both human use sytems and natural event systems. People respond cognitively to the hazard through their perception of both the event and choices of adjustment, and then they take action to mitigate the hazard. Such action has its consequences, and these will be reflected in both human and natural event systems. This new interaction may create a new hazard. This model proposes that humans are not a passive element, but continually adjust to new sets of circumstances in the physical and social environment. For some individuals, the way to avoid these new circumstances may be through no overt behavior, while for others it may mean the construction of billion-dollar engineering schemes (Sorensen and White, 1980).

1.4.4.1 Perception of drought:

Some studies have suggested that drought is perceived as a lack of rainfall (e.g., Ibrahim 1981; Wilken 1982). Heathcote (1969) related the definition of drought in Australia to the perception of drought. If local people perceive there is drought, others may accept this perception as a fact. In reference to Brazil, Brooks (1982), agreed with Heathcote (1969) that perception is a judgement of personal vulnerability to the threat of drought.

Saarinen (1966) discovered that farmers consistently underestimated the frequency of years when drought was experienced, and were optimistic about the number of good years and about the size of crops in such years.

Hazard perception differs from one person to another. Variations in hazard perception were explained in terms of the relation of the hazard to the dominant resource use, the frequency of occurrence of the hazard, and variations in the degree of personal experience. Increased perception occurs where the hazard is directly related to the resource use. Thus, agriculturalists are more aware of the flood hazard than urban dwellers, while wheat farmers perceive the drought hazard more readily than cattle ranchers (Saarinen 1976:155).

In general, however, the literature does not deal with the farmers' and nomads' interpretation of the meaning of the term drought. Only Wilken (1982) and Ibrahim (1981) addressed farmers' interpretations of drought as a lack of rainfall. No one apart from Ibrahim (1981) has examined the nomads' interpretation of drought.

1.4.4.2 Awareness of drought:

It has been hypothesized that hazard awareness is a very important factor in hazard response. Many writers have explored this relationship including Burton, Kates and White (1978), Kates (1962) and McPherson and Saarinen (1977). The fundamental logic behind the relationship between hazard awareness and hazard mitigation is that in order for people to take action to mitigate the potential adverse effects of an event, they must have some knowledge of both the probability and possibility of the event and its potential consequences (Waterstone 1978). With regard to drought, Saarinen (1966) found that there is a direct relationship between drought perception and adoption of adjustments. One reason for this relationship may be that in the case of the Great Plains, the awareness of drought by wheat farmers is a central concern, because their very livelihood depends on it.

Some studies show that the vast majority of people in hazard-prone areas are aware of drought. In some cases, the degree of awareness is very high (Brooks 1973; Dupre and Roder 1974; Ibrahim 1977, 1981; Wilken 1982). In other cases, adjustment to drought was minimal, since the degree of awareness was quite low (Brooks 1982). It is unlikely all respondents perceive the hazard to the same degree; for example, Kirkby (1974) found that 66% of the respondents in Mexico could not name any extremely dry years.

1.4.4.3 Drought past experience:

Hazard scholars claim that past experience plays an important role in hazard awareness(e.g., Burton, Kates and White 1968). More importantly, some writers have claimed that the severity and immediacy of hazard plays a greater role in hazard awareness and perception. Specifically, Schiff (1977) stated that extensive adverse experience is the most powerful agent of persuasion. Persons who have experienced a flood or other damaging natural event exhibit a much stronger propensity to adopt adjustment, and the propensity appears to increase with the magnitude, intensity, and frequency of experience. Schiff (1977) also stated that prior experience is not an extremely powerful explanatory variable, along with other variables including age, sex, income and education.

Many studies have suggested that people in drought stricken areas stated that they had experienced drought (Brooks 1973; Hall 1978; Hankins 1974; Heijnen 1974; Ibrahim 1981; Oguntoyinbo and Richard 1978; Saarinen 1966). Ibrahim (1981) and Saarinen (1966) found that intensive experience had increased the peoples' awareness and perception of drought. This does not seem to hold true for the very oldest farmers of the Great Plains, who as a group appear to be much less perceptive, despite their great experience (Saarinen

1966).

1.4.4.4 Adjustment to drought hazard

Adjustment to drought hazard is viewed as occurring after the cognitive processes of the individual have been at work (Burton, Kates and White 1968).

Many attempts have been made in the U.S.A. to alter the effect of drought by cloud seeding, although such attempts did not show any encouraging results. The most commonly practised method of affecting the cause of drought in Africa is to pray for Gods' help and by presenting sacrifices (Berry et al. 1971; Campbell 1984; Dupree and Roder 1974; Heijnen and Kates 1974; Ibrahim 1977, 1981; Oguntoyinbo and Richards 1978; Wisner 1976).

People believe that drought hazard could be modified through an increased utilization of rainfall. The drought of the 1930s in the Great Plains of America encouraged the development of many soil and moisture conservation practices, such as terrace and contour farming, strip cropping, stubble mulch farming, and minimum tillage (Rosenberg 1978:123).

Another moderating effect of drought hazard is irrigation. Some of the methods practised by peasant farmers are planting dry, intercropping, mixing of crops and replanting, planting with the first rains, tie-ridging, and irrigation (Berry et al. 1971; Hall 1978; Hankins 1974; Heijnen and Kates 1974; Ibrahim 1977, 1981; Wilken 1982; Wisner 1976).

Other adjustments such as changing land use, land management, farm fragmentation, and cultivation of drought resistant crops are some examples from developed and developing countries. These methods were adopted in order to modify the loss potential of drought (Campbell 1984; Ibrahim 1981; Pickup and Minor 1980; Porter 1978; Scott 1979; Wilken 1982; Wisner 1976).

People adjusted to losses by: (1) bearing the loss: this could happen by storing food, buying food, selling animals or migration (Berry et al. 1971; Ibrahim 1981; Wisner

1976); (2) Sharing the loss: purchasing hazard insurance, but this is only possible in the developed countries; and (3) Federal help (i.e. U.S.A.), which starts with forming a drought emergency task force (Crawford 1978). The Australian government helps drought victims through the offer of drought loans and other subsidies (Martin 1983). In some cases, a national plan and a drought act is established, as in England (Burton, Kates and White 1978).

1.4.4.5 Adjustment of the nomads to drought:

The most common method of adjustment to drought adopted by the nomads is migration. In fact, migration is not only a means of adjustment, but most important, it is the central point of nomadic life. Other adjustments adopted by the nomads include selling of animals (Asher 1985; Campbell 1984; Goldschmidt 1981; Ibrahim 1981) and carrying out agricultural activity (Baier 1980; Campbell 1984; Ibrahim 1981; Kloos 1982; Tubiana and Tubiana 1977). Because nomads practise farming, this does not deny the fact that the nomads depend totally or partially on settlers for their supply of grain (Baier 1980; Berry et al. 1977; Ibrahim 1981). Nomads also practise fishing (Kloos 1982; Salzman 1980). In times of hardship, nomads circulate or exchange livestock with relatives or friends in order to spread the risk (Campbell 1984; Goldschmidt 1976; Kloos 1982; Porter 1978; Schneider 1957). Nomads also pray for rain (Campbell 1984) as a method of adjustment.

1.4.5 Studies of drought and desertification in the Sudan

Very few studies have been conducted on drought in the Sudan and those that have been conducted have been limited in their scope. Abu Sin (1984), Ibrahim (1977, 1981) and Tubiana and Tubiana (1977), investigated the social aspects of drought, while Awadalla (1981), El Tom (1972), Hammer (1972), Hulme (1984), and Trilsbash and Hulme (1984), dealt with the physical aspects of drought.

Although drought has been a real problem in the semi-arid areas of the Sudan since the mid 1960s (Ibrahim 1977, 1981; Trilsbach and Hulme 1984), it has not received as much attention as desertification. This was reflected in the improper implementation of drought relief programmes in 1984 due to the absence of national short or, long-term drought management plans (Asher 1985; Miller 1985).

In contrast, a national plan to control desertification was established in 1976 (Sudan's Desert Encroachement Control Rehabilitation Programme - D.E.C.A.R.P.). DECARP (1976:1) identified the problem as "a man made phenomenon," and other studies seemed to agree with this approach (e.g., Ibrahim 1978; Environmental Conservation 1984; Rapp 1976; Rapp and Hellden 1979). Because desertification was dealt with separately from drought, some changes were required, and have occurred recently. For example, it has been admitted that drought and desertification are interrelated (Hare 1984; Matheson 1984; Nature and Resources 1984). Moreover, drought has been described as an engine of desertification (Walls 1984). Other researchers (Hare 1984) have now suggested drought plans are fundamental to the struggle against desertification.

Many studies concerning desertification have been undertaken. (e.g., DECARP 1976; Ibrahim 1978, 1983; Lamprey 1975; Rapp 1976; Rapp and Hellden 1979; Stebbing 1953). A number of conferences also have been held (e.g., Al Obeid 1982; Al Fasher 1982; University of Khartoum 1983). A new journal, "At-Tasahhur," the "Sudan Journal of Desertification," also has been published since 1983.

The field survey showed that these studies and conferences have increased the awareness of the people about desertification. Although some respondents in this study mentioned the term "desertification" as one of the natural problems of farming, they still have no clear idea of the true meaning of the term "desertification." They often referred to wind as "desertification," even with the availability of good vegetation cover in the surroundings. One of the projects established to combat desertification and also to increase humidity in the air is the reforestation of the gum arabic belt (Abu Baker 1983).

In conclusion, the development of strategies designed to combat desertification separately from drought in a country like the Sudan, which suffers from both phenomena, is incomplete. Moreover, the absence of and the lack of interest in drought studies and plans have contributed to the problems which accompanied the relief programme during the 1984 drought. In fact it was drought that drove nearly three million Sudanese in the semi-arid areas out of their homes (Dobri 1985). It is high time that desertification and drought be treated equally if any plan is to be established to maintain the ecological balance in the semi-arid areas. This study addresses this large gap in the literature.

1.4.6 Response of international donors to the 1984 drought

The current African drought intensified in 1983, to the extent that the Director-General of FAO pointed out that 22 African countries were suffering from food shortage (Kamm 1983). By November 1984, the list of affected countries grew to almost 30 countries (Watson et al. 1984). However, the response to the drought by international donors was not prompt (Hackett 1984; Iyer and Wilde 1984). Meanwhile, media representation of drought affected areas was inbalanced. Among the affected countries, Ethiopia received more publicity, while Mozambique, Chad, Mauritania, and Angola received less publicity, although these countries suffered from drought and in some cases, war. (Watson et al. 1984).

Donors responded well to the famine in Ethiopia. However, because of the "poor management of the crisis" by the Ethiopian government (McKay 1984), food aid did not reach in famine areas in time. Some management problems which were encountered in the distribution of food aid to some affected countries included lack of sufficient transportation (Asher 1985; McKay 1984; Miller 1985), lack of coordination between the different international donors (McKay 1984; Miller 1985), and corruption (Miller 1985). However, the literature emphasized that besides food aid, Africa should be assisted to maintain a self-sustaining development and growth pattern, which implies pre-disaster planning (Apeldoorn 1981; Bloch 1984; Danforth 1984; Lewis et al. 1976; Mayer 1984; Watson et al. 1984).

1.5 Detailed gaps in the literature

In addressing the question of adjustment to drought hazard by the peasant farmers, the literature has failed to focus on the following issues: preparation for drought; changes in farm operation; mixing of crops; replanting and intercropping; seed dressing and treatment; diffusion of crops, especially the quick-maturing crops; the number and the role played by animals owned by the peasant farmers; interaction of adjustment between the peasant farmers and the pastoral nomads; adverse affect of adjustment; attitudes towards adjustment (the effectiveness of adjustment); and the role of attitudes and beliefs in adjustment. These questions are addressed in this study in an effort to fill the gaps in the literature.

With regard to the nomads' adjustment to drought, the literature does not focus on the mode of migration, the changes that occur in the course of migration, attitudes of the nomads towards the new areas in which they recently arrived, problems encountered in those new areas, nomads' attitudes towards adjustment (effectiveness of nomads' adjustment), the types of crops, size of the farm cultivated by the nomads, crop yields, and the extent to which nomads depend on settlers' grain. This study addresses these gaps in the existing literature.

The literature also has ignored the role played by the policy-makers (government officials) in the Sudan. Their perceptions of drought in relation to other problems, their perceptions of methods to overcome or reduce the drought, assistance given to drought victims, and the efforts undertaken to develop traditional agriculture and the nomadic way of life which were believed to be a major step towards improving the traditional life of farmers and nomads. Each of these measures would overcome or at least lessen the effect of drought. An examination of the problems listed above is important before any sound plan of drought control can be instituted.

1.6 Summary of the thesis structure:

In Chapter 2 the physical setting of the study area is discussed. Methods of data collection are presented in Chapter 3. Chapter 4 discusses the socio-economic characteristics and cultural adaptations of the peasant farmers and the pastoral nomads to the environment. The extent of drought in the Sudan as a historical and a contemporary problem is presented in Chapter 5. This chapter also presents a discussion of the impact of drought on crop yields, animals and animal products, prices of grains, social life, and the natural environment. Chapter 6 deals with the perception of drought hazard, while adjustment to drought hazard is presented in Chapter 7. Adjustment of government officials to drought, and a comparison between the perception of and adjustment to drought hazard by policy-makers and resource users are discussed in Chapter 8. Finally, in Chapter 9, a summary and the conclusions drawn from the research are presented.

Chapter 2

Physical Environment of the Study Area

This chapter describes the main features of the physical environment within the study area.

The two regions of Eastern Kordofan and Eastern Darfur, which comprise the study area, will subsequently be referred to as E. Kordofan and E. Darfur. Similarly, the peasant farmers and the pastoral nomads will sometimes be simply referred to as the farmers and the nomads. Although E. Kordofan is located between latitudes 12°.15'N and 14:50'N and longitudes 30°.20'E and 32°00'E, the majority of references made to E. Kordofan refer to the area between latitudes 13°00'N and 14°.00'N. E. Darfur is located between latitudes 11°.48'N and 14°.00'N and longitudes 25°.47E and 27°.30'E, a total area of 26,700 Km^2. This compares very closely with the total area of 26,776 km^2 for E. Kordofan.

Administratively, E. Kordofan is divided into 5 rural councils, these are Um Rowaba, Er Rahad, Um Dam, Shirkala and Ashana. E. Darfur, however, is composed of only two rural councils; Um Kaddada and Al Ayit, sometimes referred to as Um Kaddada R.C. and Al Ayit R.C.

2.1 Population

According to the 1983 National Census, the population of E. Kordofan was 461,950; the majority living in the rural areas (418,487), and 43,463 living in urban areas. This census also showed that 105,114 people were inhabiting E. Darfur, and the majority are rural dwellers. The rate of annual population growth is 3.9% in E. Kordofan and 2.7% in E. Darfur (Table 2.1).There is no clear idea as to the exact number of nomads in both regions, because it was not shown in the 1983 census. The 1955 census, however, showed that the pastoral nomads in the Sudan represented 10% of the total population of the country according to Ahmed (1976). In 1970 it was estimated as 15% (Khogali 1980).

TABLE 2.1
Population of E. Kordofan and E. Darfur in
1973 and 1983

Area	1973	1983	Rate of annual growth
E. Kodofan	300205	461,950	3.9%
E. Darfur	82708	105,114	2.7%

Source: Department of Statistics - Sudan (1983)

The economy of the Sudan depends predominently on agricultural production. This is based on irrigation together with mechanized and traditional rainfed agriculture. Traditional rainfed agriculture is practised by a large proportion of the rural population in Kordofan and Darfur regions using hand tools. The contribution of traditional agriculture in both regions is large in relation to the total land productivity of the country.

Table 2.2 shows that, in Kordofan and Darfur regions, 86% of Sudan's*dukhn* (millet) is produced. This is the most important food crop in western Sudan. The production of *dura* (sorghum) in the two regions comprises 56% of that produced by traditional agriculture in the country. This figure does not include the production from mechanized and irrigated schemes. Darfur and Kordofan also produce 77% of the country's groundnuts and 62% of the sesame produced by traditional farming methods.

In terms of animals wealth, Kordofan and Darfur regions, hold approximately 40% of the Sudan's national domestic herd; 7.8 million cattle, 6.7 million sheep, 5.5 million goats and 1.5 million camels. (WSARP 1982)

TABLE 2.2
Area and production of 4 major crops in Kordofan and Darfur regions in relation to other part of the Sudan in the 1982/83 season

Crop	Area in(thousand)feddans		Production(thousand)m/T	
	n	%	n	%
Dukhn(millet)	2145	91	195	86
Dura(Sorghum)	1390	49	270	56
Groundnuts	1105	80	245	77
Sesame	460	92	439	62

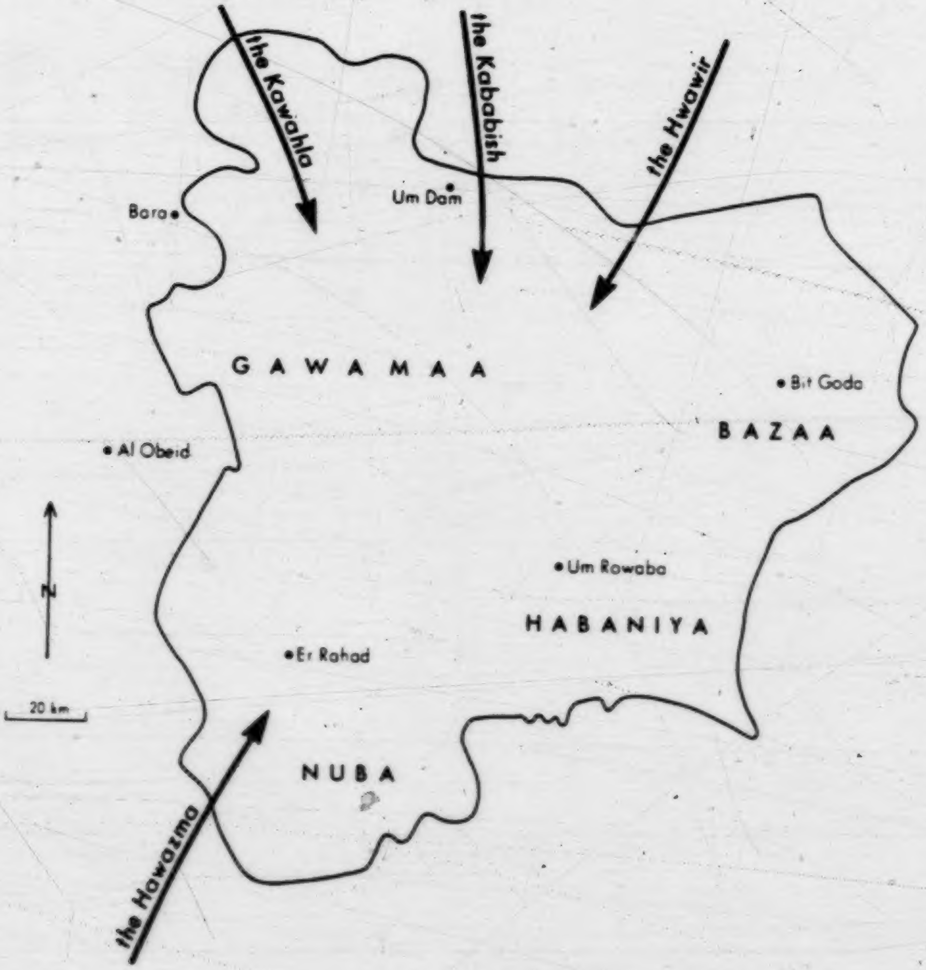
Source: Agricultural Statistics, Department of Agricultural Economics, Ministry of Agriculture, Sudan

2.2 Tribal composition

E. Kordofan is inhabited by five main tribes; the Gawamaa, Bazaa, Habaniya, Nuba and the Shanabla. The Gawamaa are the largest tribe in E. Kordofan. The Bazaa and Nuba are sedentary cultivators. Some of the Gawamaa keep large herds of animals which they move with. The Shanabla and Habaniya are nomads.

The Shanabla are hosted by the Gawamaa tribe. Some of the Shanabla have lost their animals and have become cultivators, leading a sedentary life. What is unique about the Shanabla is that they are the only nomadic tribe in the Sudan who have no homeland (*Dar*). This is due to the fact that they were the last Arab tribe to enter the Sudan (Abdalla 1984). They are the only pastoral nomads in the Sudan who have a rural council (Al Shanabla R.C.), but it does not have a fixed geographical boundary.

Due to the current drought, the area is also visited in early summer by the northern tribes like the Kababish, Kawahla and the Hwawir. They remain in E. Kordofan until the beginning of the rainy season. The Hawazma enter the area from the south during the rainy season (Figure 2.1).


the Kawahla
the Kababish
the Hwawir
Um Dam
Bara
GAWAMAA
Bit Goda
BAZAA
Al Obeid
N
Um Rowaba
HABANIYA
Er Rahad
20 km
NUBA
the Hawazma

Source: U. N.(1966) and Field survey (1983)

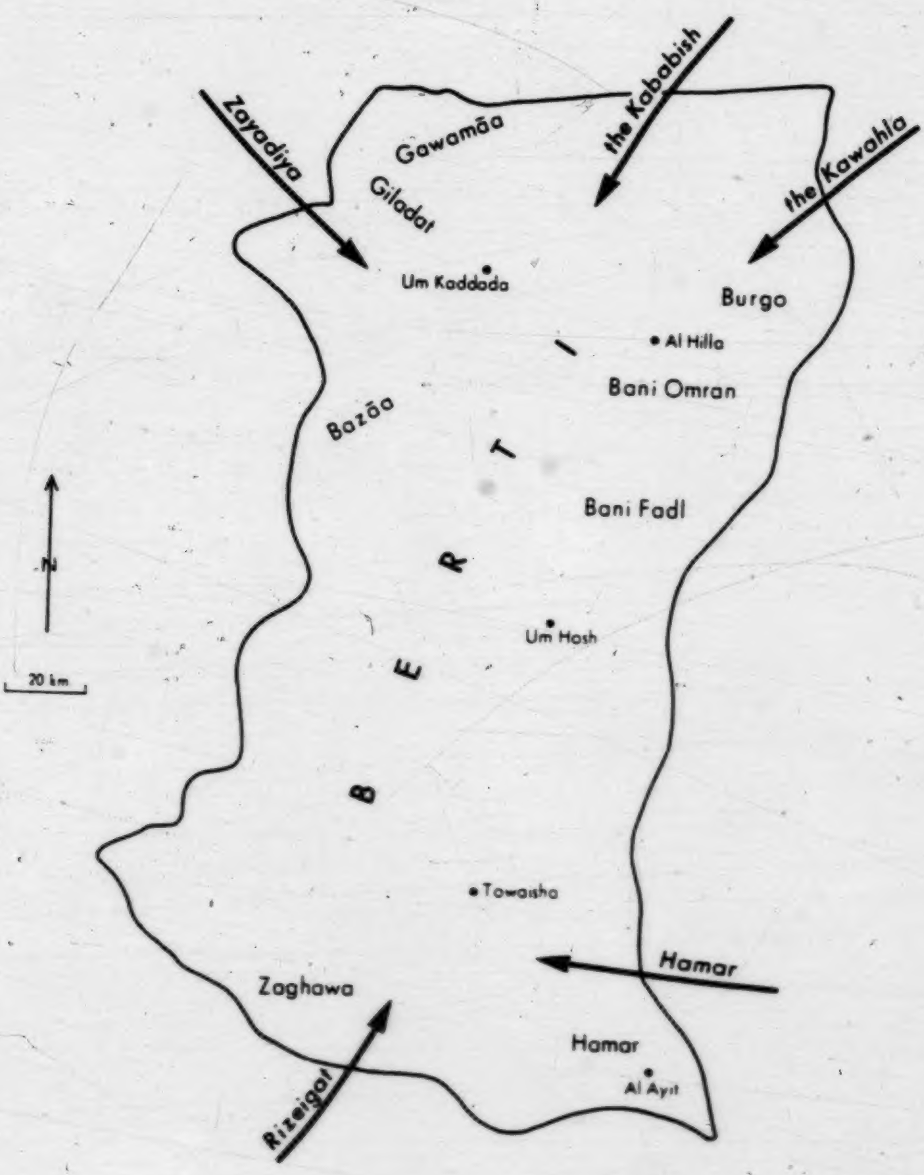
Figure 2.1 Tribal composition of East Kordofan

E. Darfur is also known as Dar Berti, from the name of the main tribe that lives there. Figure 2.2 shows that besides Berti there are small communities representing different tribes such as Gawamaa, Kaja and Giladat in the north; the Burgo, Bani Omran and Bani Fadle in the east; the Hamar and Zaghawa in the south, and the Bazaa in the west. All of these groups are sedentary cultivators, although some keep animals and move with them. Like E. Kordofan, the region is visited by some nomadic tribes during both the dry and wet season. The Kababish and the Kawahla migrate to the region in the summer (May and June) from the north, while Zayadia arrive at the same time from the north-west. Hamar enter from the east, Rizeigat visit the area at the beginning of the rainy season (July) from the south, escaping the period of the biting flies in their home. These tribes stay in E. Kordofan and E. Darfur for a period of two months.

The Shanabla, the Kawahla, the Kababish, the Hwawir, Hamar and Dar Hamid are primarily camel raising tribes (*Abbala*), although they also keep variable numbers of sheep and goats. The remaining tribes keep different types of animals, primarily sheep, and to a lesser degree cattle and goats. The Hawazma and the Rizeigat enter the study area from the south; they were not included in the sample because they were not there during the period of the field work. Both the Hawazma and the Rizeigat are cattle owners (*Baggara*). During the course of the study some 16 separate tribes were interviewed (Table 2.3).

2.3 Geology

The study area is dominated by four geological formations: Basement complex, Nubian standstone, Um Rowaba and Nawa formations. (Figure 2.3 and 2.4). The Nubian sandstone and Um Rowaba formations are important sources of ground water (Rodis et al. 1964; Strojexport 1976).


Zayadiya
the Kababish
the Kawahla
Gawamãa
Giladat
Um Kaddada
Burgo
Al Hilla
Bani Omran
Bazãa
Bani Fadl
N
20 km
Um Hosh
B E R T I
Towaisha
Hamar
Zaghawa
Hamar
Al Ayit
Rizeigat

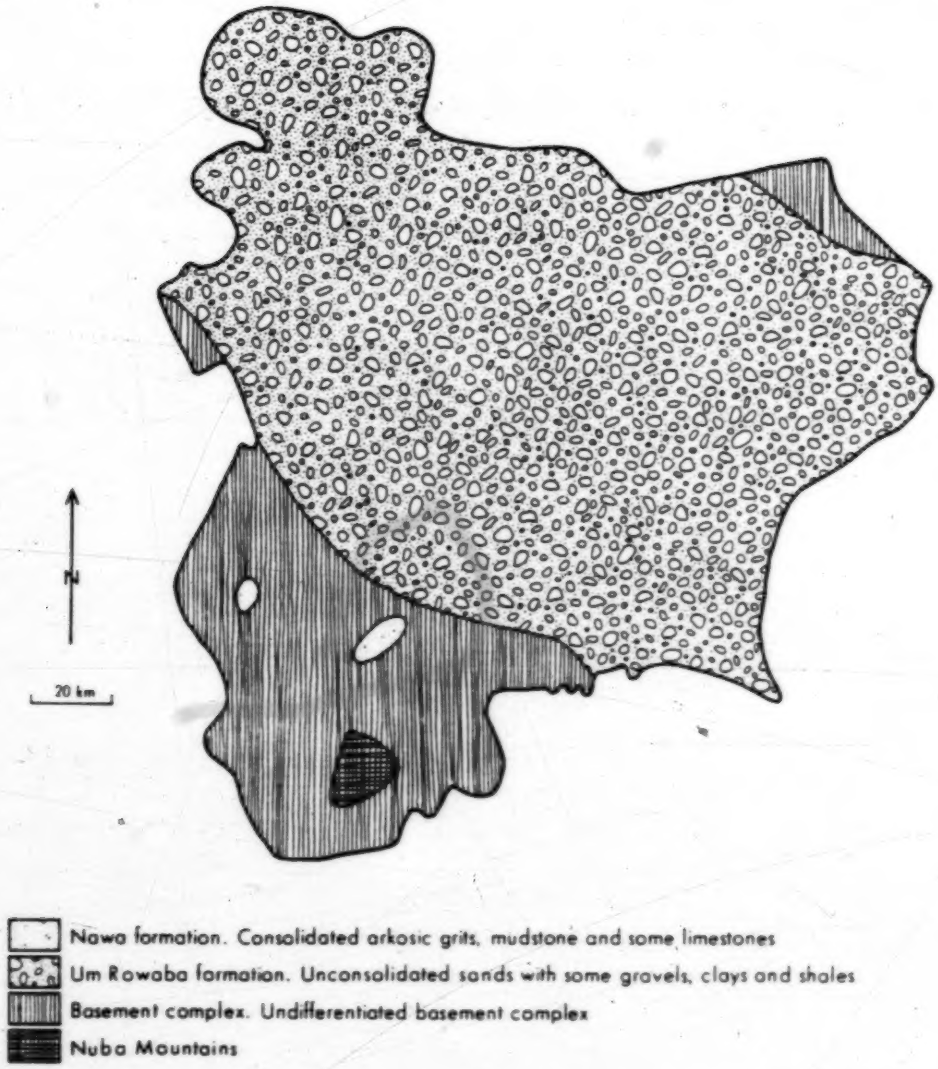
Source: Field survey (1983)

Figure 2.2 Tribal composition of East Darfur

TABLE 2.3

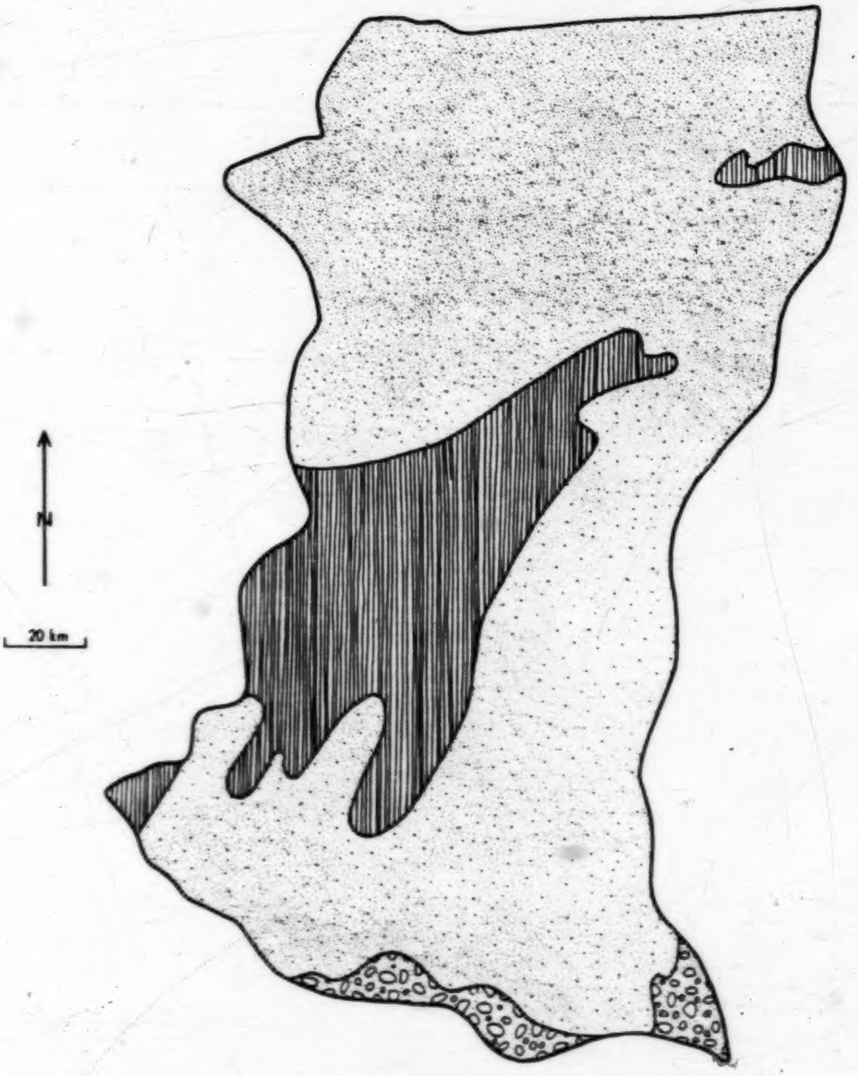
Nomadic tribes of the study area

Tribe	N	%
The Shanabla	62	29.8
The Kawahla	40	19.2
The Kababish	32	15.4
The Gawamaa	18	8.7
Zayadia	14	6.7
Tungor	10	4.8
Beni Garar	9	4.3
Berti	6	2.9
Dar Hamid	5	2.4
The Hwawir	3	1.4
Hamar (Beni Badr)	3	1.4
Bazaa	2	1.0
Falata	1	0.5
Hussania	1	0.5
The Zaghawa	1	0.5
Rawashda "Gimaa"	1	0.5
Total	208	100.0


N
20 km
Nawa formation. Consolidated arkosic grits, mudstone and some limestones
Um Rowaba formation. Unconsolidated sands with some gravels, clays and shales
Basement complex. Undifferentiated basement complex
Nuba Mountains

Source: Geological Map of the Sudan (1981)

Figure 2.3 Geology of East Kordofan



⛆ Nubian sandstone formation. Continental clastic sediments, including: sandstones, siltstones, mudstones and conglomerates

▨ Um Rowaba formation. Unconsolidated sands with gravels, clays and shales

▥ Basement complex. Undifferentiated schist group: meta sediment, marble, quartzites, graphite and mica schists

Source: Geological Map of the Sudan (1981)

Figure 2.4 Geology of East Darfur

2.4 Geomorphology and Soils

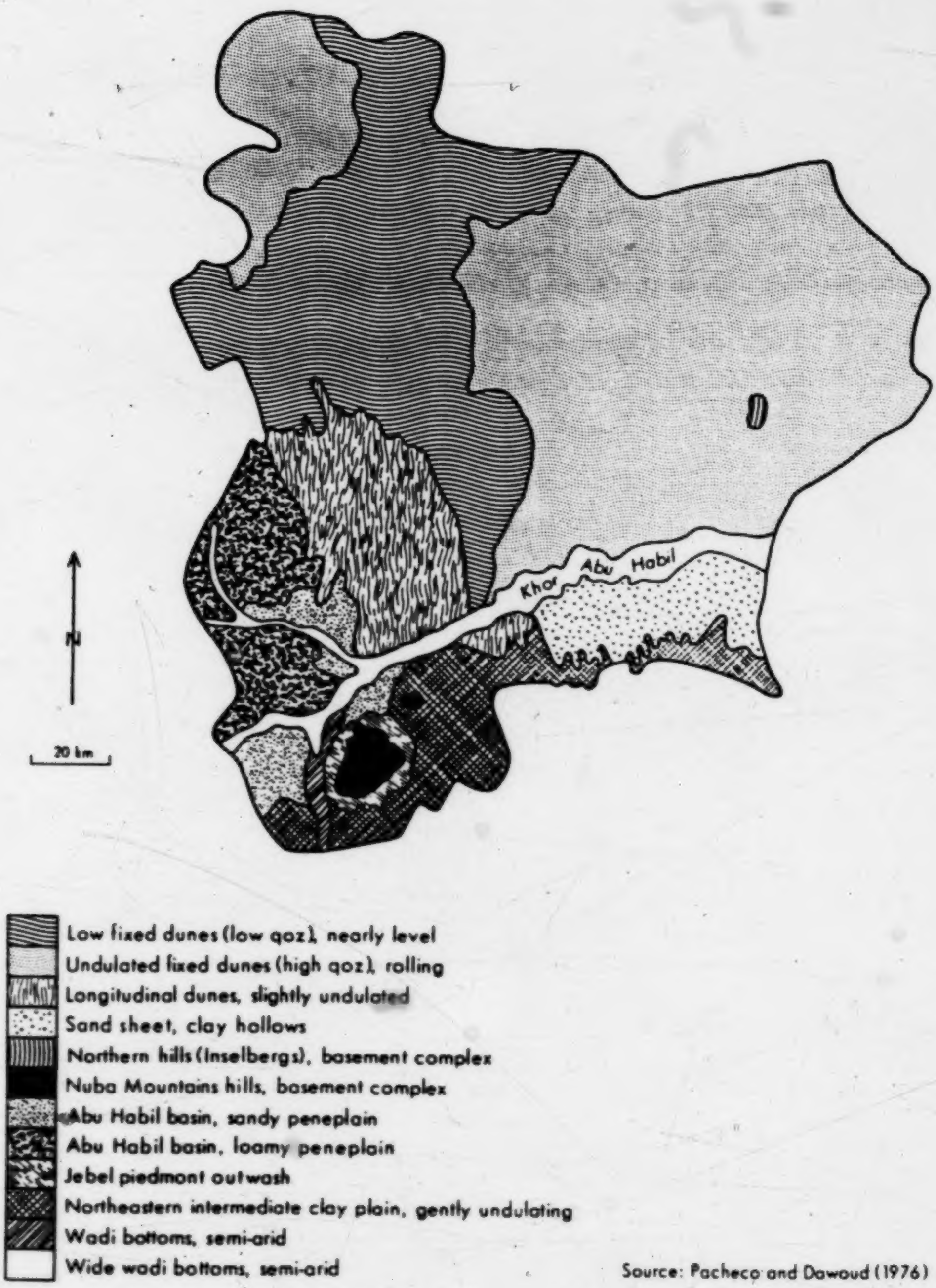
With the exception of the southern part of E. Kordofan, the study area occurs within what is called locally the "*Goz*". This is the most extensive of the Pleistocene and recent deposits in the area north of latitude 11°30' N. It consists almost entirely of sandy soils (Pacheco and Dawoud 1976); the study area is not merely undulating sand dunes or extended sand sheets which characterizes most of the *Goz*, rather mountains and hills (inselbergs) are found in many areas in both E. Kordofan and E. Darfur. These inselbergs are formed as a result of the Basement Complex and the Nubian sandstone outcrops. In E. Kordofan these are exemplified by the Nuba Mountains and the northern hills(Figure 2.5). In E. Darfur, both the Basement Complex and the Nubian sandstone outcrops are found in the western and the northern parts of the region (Figure 2.6).

The study area has few streams and therefore a poor drainage system with the exception of Khor Abu Habil and some other smaller streams radiating from the Nuba Mountains and the inselbergs. This is due to the sandy soils (*Goz*) which cover most of the area, and which cause most of the rainfall to percolate into the sand.

Chemical analysis carried out by the U.N. (1966) revealed that *Goz* soils are deficient in nitrogen and phosphorus, but their potassium content is good. Their organic carbon level is low and so too are their calcium and magnesium values. Such infertile soil does not support continuous cultivation for long periods. Continuous cultivation in such soils ranges between four and six years and in a few cases up to 10 years.

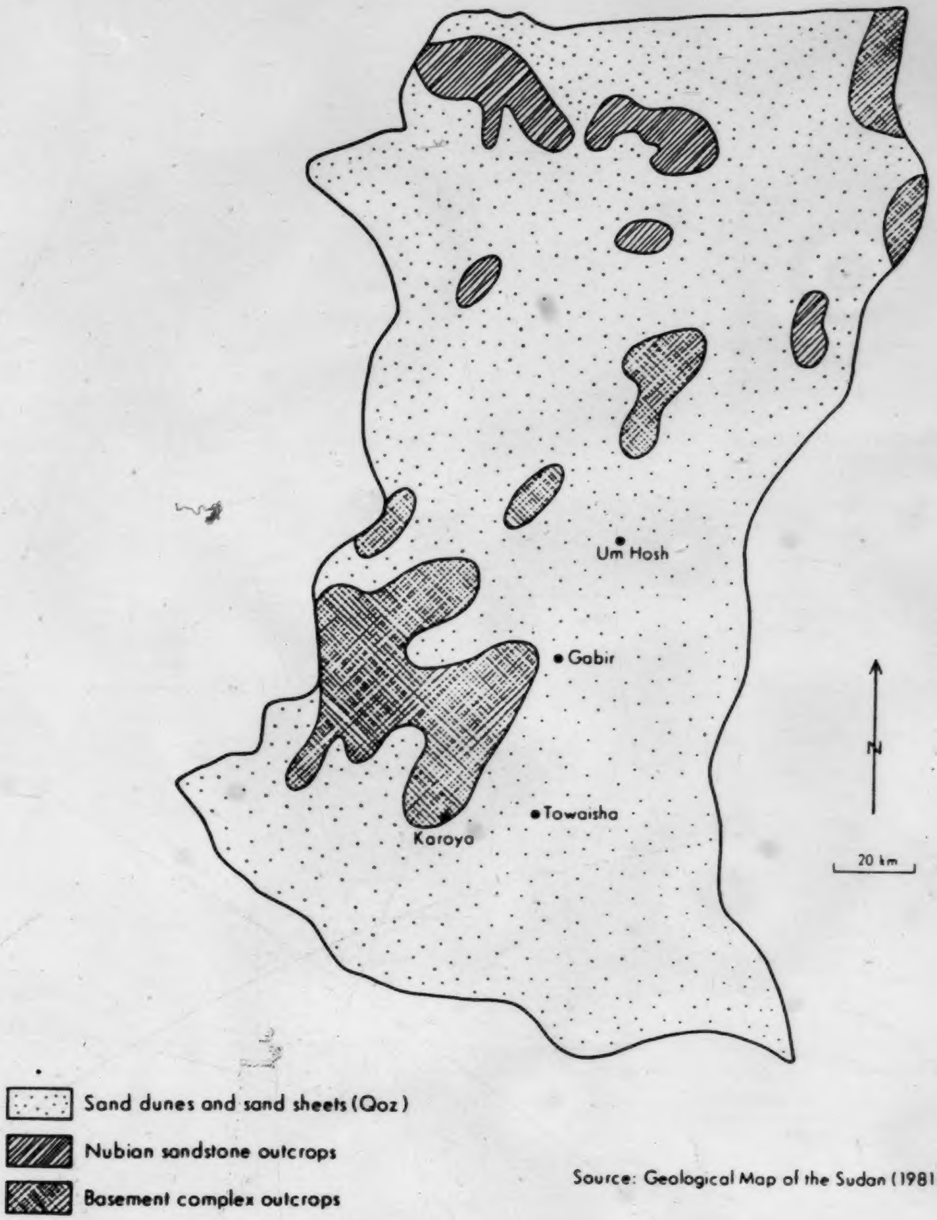
2.5 Climate

A tropical continental climate prevails over most of the Sudan. It merges into the equatorial rainy climate in the south, and into the desert on the north (Approx. lat. 18°N). Between these two extremes a Savanna climate dominates part of central and most of southern Sudan. The climate of the Sudan has an alternate dry and wet season over the majority of the country. The wet season is more prolonged to the south and becomes progressively shorter to


Khor Abu Habil
N
20 km
Low fixed dunes (low qoz), nearly level
Undulated fixed dunes (high qoz), rolling
Longitudinal dunes, slightly undulated
Sand sheet, clay hollows
Northern hills (Inselbergs), basement complex
Nuba Mountains hills, basement complex
Abu Habil basin, sandy peneplain
Abu Habil basin, loamy peneplain
Jebel piedmont outwash
Northeastern intermediate clay plain, gently undulating
Wadi bottoms, semi-arid
Wide wadi bottoms, semi-arid

Source: Pacheco and Dawoud (1976)

Figure 2.5 Geomorphology and soils of East Kordofan


Um Hosh
Gabir
Towaisha
Karaya
N
20 km
Sand dunes and sand sheets (Qoz)
Nubian sandstone outcrops
Basement complex outcrops

Source: Geological Map of the Sudan (1981)

Figure 2.6 Geomorphology and soils of East Darfur

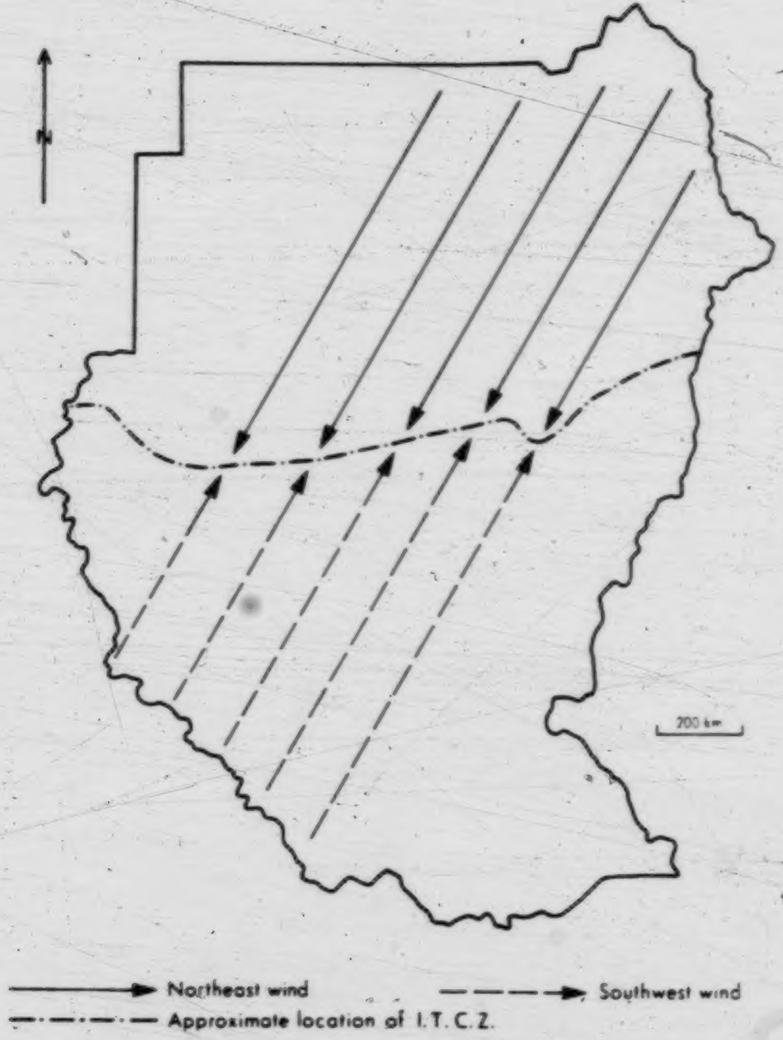
the north (Barbour 1961; El Tom 1975; Lebon 1965)

The Sudan climatic year can be divided into two seasons, winter (late Oct - March) and summer (April - Oct.). There is a marked difference in temperature between the winter and the summer as well as between the northern and the southern parts of the country. In winter the mean daily temperature varies between 15.9°C in the north, and 28.8°C in the extreme south. In the summer the temperature in northern and central Sudan reaches its highest point in May and June. The highest mean daily maximum temperature recorded was 39°C at Al Obeid in the 1951-80 period.

2.5.1 Rainfall

Two wind systems are dominant over the Sudan. The dry continental N.E. winds dominate during the winter (Oct.-March), whereas the southwestern monsoonal winds from the Atlantic Ocean advance northward, and by September reach the Southern fringes of the desert (Figure 2.7). They are responsible for most of the summer rains of the Sudan; the humid southwesterly winds reach the Sudan towards the end of March and by April they normally dominate a large part of southern Sudan. They continue moving northward at the expense of the north easterly winds which are forced to retreat gradually in the face of the advancing southwesterly winds. By the end of August, or early in September, the moist winds reach their most northern position over the country which, on the average, lies somewhere between latitudes 18° and 20° north (El Tom 1975). Both winds tend to converge along a distinct transitional belt known as Inter-Tropical Convergence Zone (I.T.C.Z.).

Provided the southwesterly winds approach the Sudan from the southern and western part and advance northward, more rainfall is found there and decreases northward. With regard to the study area, which lies at the northern part of the central plains, (lat. 12°-14°N) the rainy season starts in July and lasts up to September. Moreover, the southern part of the study area in E. Kordofan, as exemplified by Um Rowaba(lat. 12°55' N), receives an average rainfall of 372 mm. This amount decreases northward to the extent that Bara receives an average of 263


N
200 km
Northeast wind
Southwest wind
Approximate location of I.T.C.Z.

Source: Adapted from El-Tom (1975)

Figure 2.7 Northeast and southwest winds over the Sudan in September

mm. On the other hand, in E. Darfur at Um Hosh (lat.12°52' N) the average rainfall is 418 mm. Whereas to the north in Um Kaddada (lat.13°36' N) the average rainfall is 238 mm. Figure(2.8). See (Figure 2.9).

High rain variability is one of the characteristics of rainfall in the semi-arid areas. Hammer(1972) explains this, by stating that a common characteristic of the precipitation maps is the patchy appearance of rainfall areas. The patchy nature of rainfall appears to be the result of *in situ* growth of clouds, combined with restricted areas of cloud development. The importance of this point lies in the fact that rainfall amounts in the semi-arid areas are not spatially evenly distributed (Trilsbach and Hulme 1984). Furthermore, Hulme (1984) states that a general drought year (across the semi-arid area) will also contain localized areas of rainfall surplus (above average).

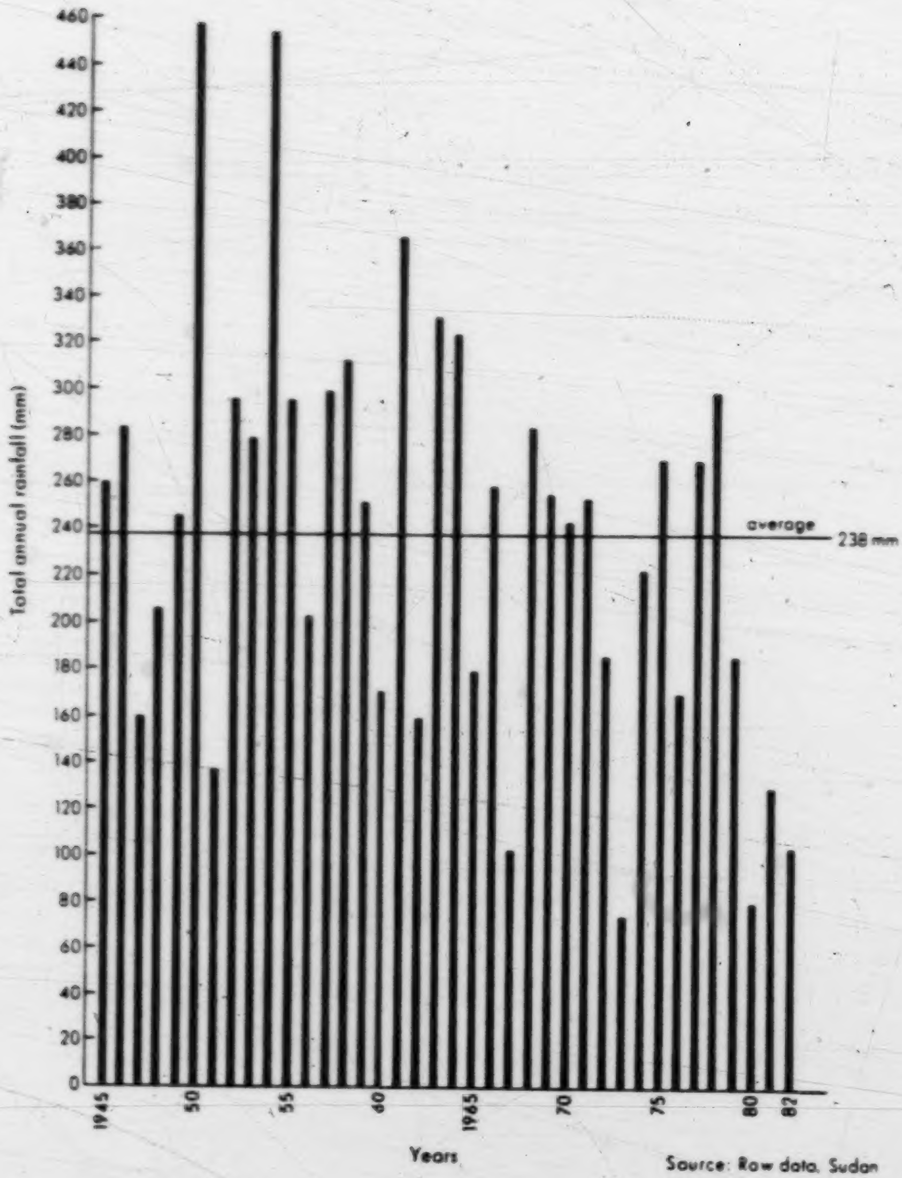
2.6 Vegetation

Throughout the Sudan there is a close relationship between the amount of rainfall and the height and density of the vegetation. (Barbour 1961; Harrison and Jackson 1958; Lebon 1965). As the amount of rainfall increases towards the southern part of the country so does the height and the density of vegetation.

Harrison and Jackson (1958), divided the Sudan into eight vegetational zones and Lebon (1965), modified this into 5 principle zones changing from north to south as follows:

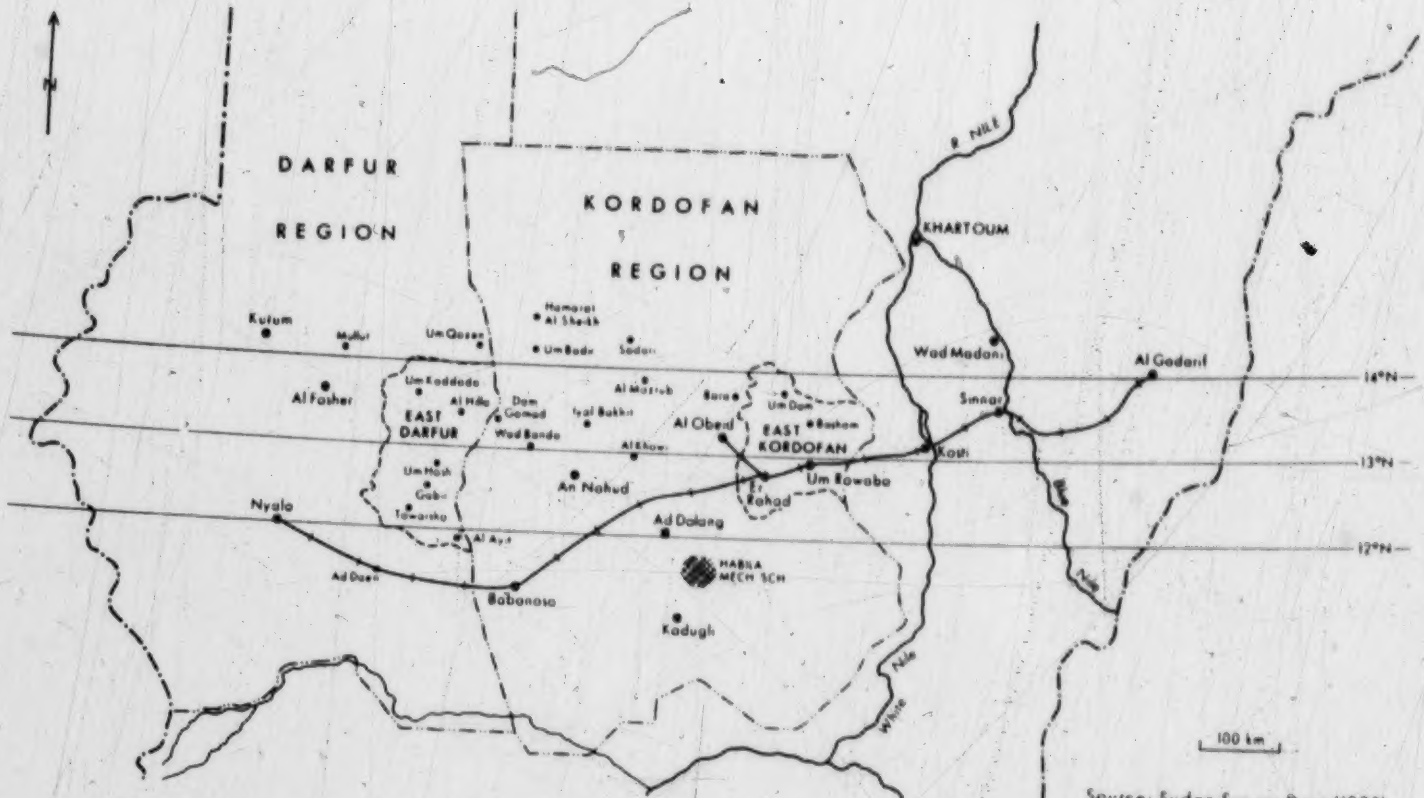
1. Desert
2. Semi-desert
3. Low woodland savanna
4. High woodland savanna
5. Tropical rain forest

Changes in these ecological zones are very frequent especially in the first three, due to drought and desertification. In addition to this Suliman (1983), stated that many plant species have disappeared in recent years.



Source: Raw data, Sudan Meteriological Dept. (1983)

Figure 2.8 Um Kaddada annual rainfall


N
DARFUR
REGION
KORDOFAN
REGION
Kutum
Mellit
Um Qozen
Hamarat Al Sheikh
Um Badr
Sodori
Al Fasher
Um Keddada
Al Hilla
EAST
DARFUR
Dam Gamad
Iyal Bakhit
Wad Banda
Al Mazrub
Bara
Um Dam
Bashom
Al Obeid
EAST
KORDOFAN
Al Khowi
An Nahud
Um Hosh
Gabi
Towaisha
Nyala
Al Ayd
Ad Daen
Babanosa
Er Rahad
Um Rowaba
Ad Dalang
HABILA
MECH SCH
Kadugli
KHARTOUM
B. NILE
Wad Madani
Sinnar
Kosti
Al Gadarif
Blue Nile
White Nile
14°N
13°N
12°N
100 km

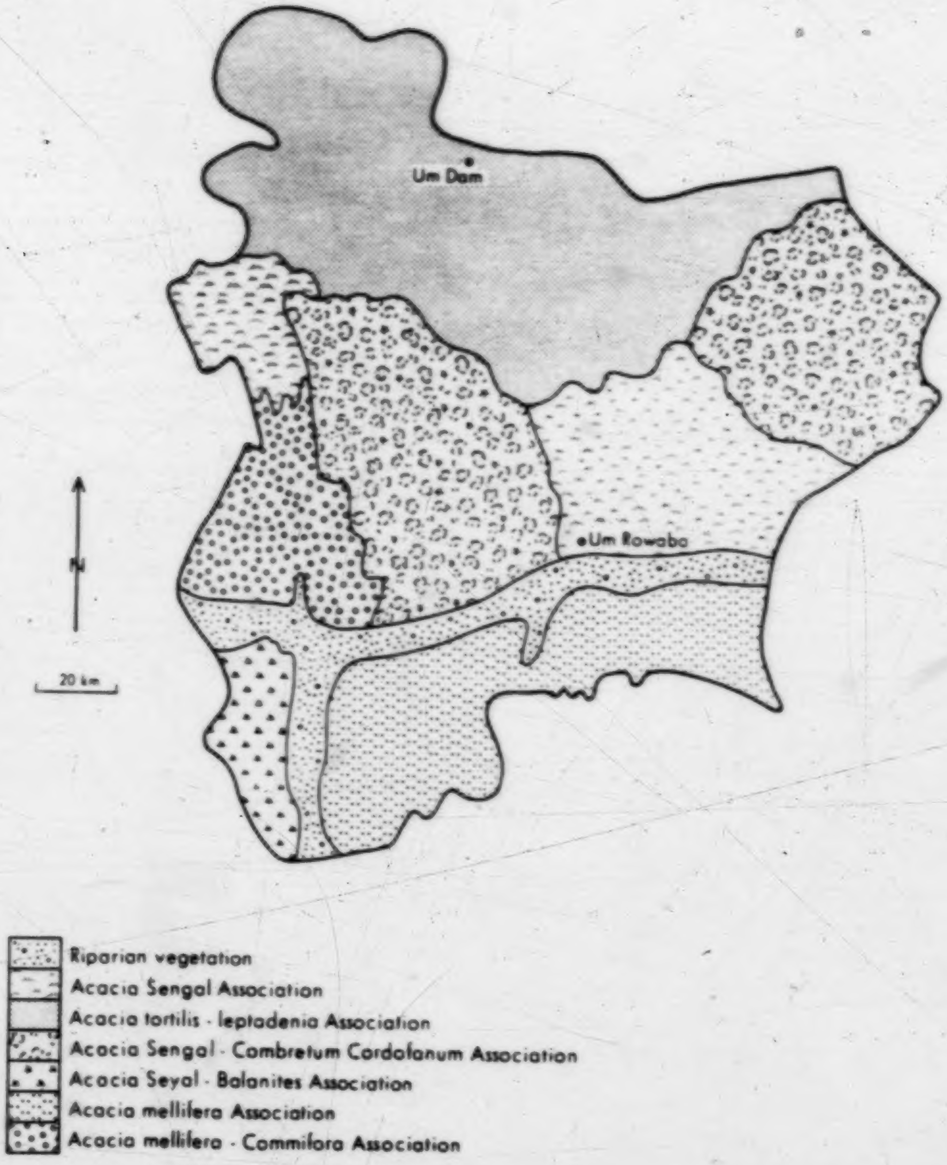
Source: Sudan Survey Dept (1983)

Figure 2.9 The study area and selected sites at the central part of the Sudan

According to the Vegetation Map of the Sudan (1983) the study area in both regions occupies part of the semi-desert and the low woodland savanna, and merges into the high woodland savanna. The vegetation species which are dominant over E. Kordofan are *acacia tortilis-leptadenia* association in the northern part with *Acacia raddiana* (sayal), *acacia senegal* (Hashab), *Balanites aegyptiaca* (Higleeg), *Combretum cordofanum* (Habil), *Cadaba glandulosa* (Sarah) and *Calotropis-procera* (Usher) in the central part of the region. However, on the clay soils (S. Um Rowaba) *acacia mellifera* association (Kitr) is found together with *acacia mellifera* and commiphora association (Gafal). Figure (2.10)

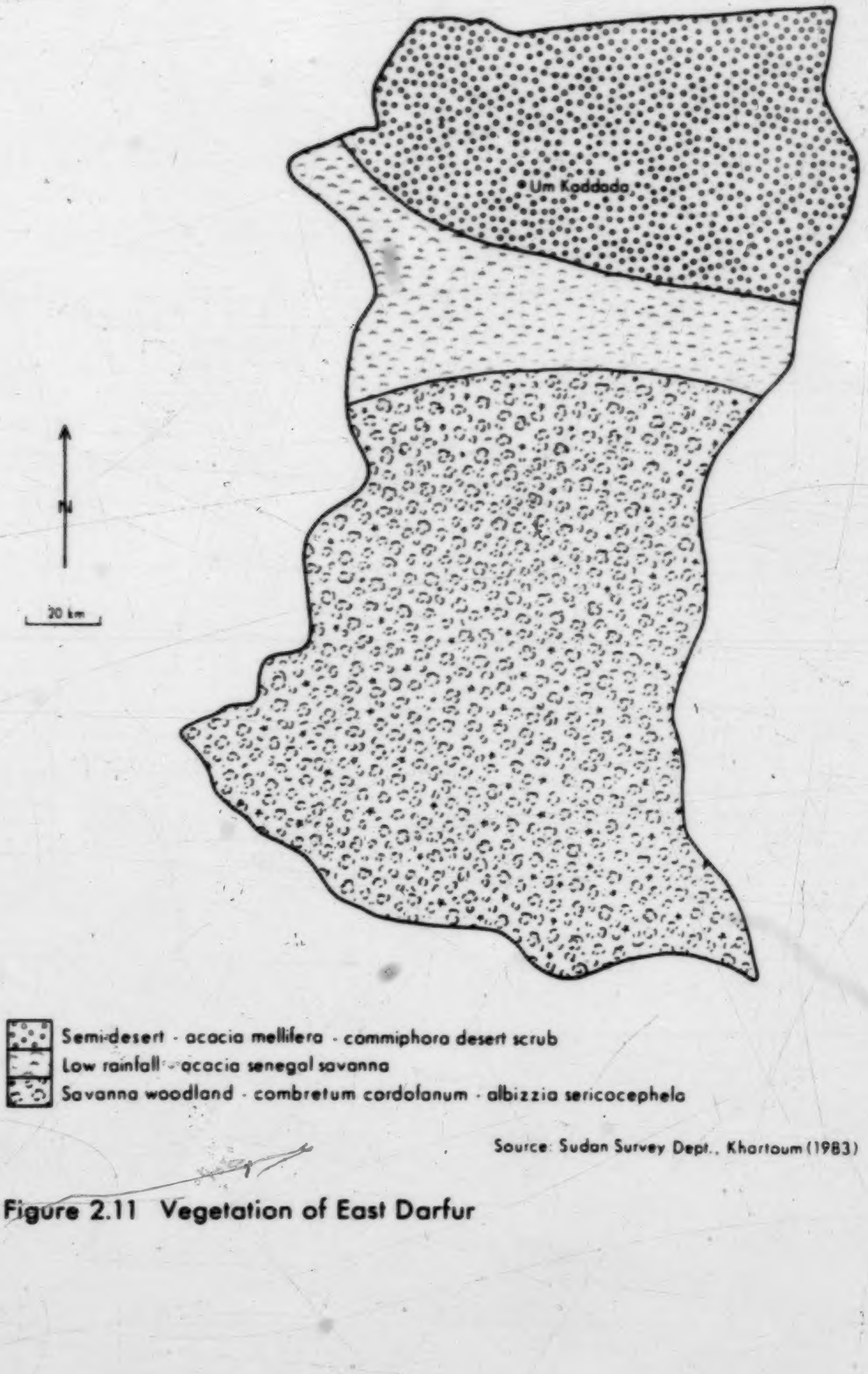
Based on field observations in E. Darfur it was found that the semi-desert ecological zone was dominated by these vegetation species, *acacia mellifera*, commiphora, *cadaba glandulosa* (Sarah), *Balanites aegyptiaca* (Higleeg), *Bosica Sengalensis* (Mikhat) and *acacia nubica* (Laot). In the second zone *acacia senegal* (Hashab), *Sclerecarya berria* (Himad), *Tamarindus indica* (Tabldi) and *Albizzia* (Arad) are the most dominant species of vegetations. In the third zone (high woodland savanna) the following vegetation species are found: *Acacia senegal* (Hashab), *Combretum cordofanum* (Habil), *Dalbergia melanoxylon* (Babanus), Albizzia (Arad), *Terminalia browni* (Durot), *Guiera senegalenais* (Gubash), *Lannea humilis* (Layon), *Dichrostachys* sp. (Kadad), *Tamarindus indica* (Aradeb), *Ziziphus spina-christi* (Sidr) and *acacia seyal* (Talih)(Figure 2.11). Dense woodland and rich pasture are seen throughout most of this last zone.

Based on the field survey it was found the dominant types of grass in both regions are *Blephavis linaviifolia* (Bigel), *Tribulus terrestris* (Dirasa), *Aristida funiculata* (Gau), *Aristida papposa* (Bayad), *Gymbopogon nervatus* (Nal), *Cenchrus biflorus* (Haskaneet), *Eragrostis tremula* (Banu), *Brachiaria* (Kureb), Cyperus (Um Tuk), Cordia (indarab), *Ipomoea* (Hantut) and *sesamum indicum* (simsim Al Gimal).


Um Dam
Um Rowaba
N
20 km
Riparian vegetation
Acacia Sengal Association
Acacia tortilis - leptadenia Association
Acacia Sengal - Combretum Cordofanum Association
Acacia Seyal - Balanites Association
Acacia mellifera Association
Acacia mellifera - Commifora Association

Source: U.N. (1966)

Figure 2.10 Vegetation of East Kordofan


Um Kaddada
N
20 km
Semi-desert - acacia mellifera - commiphora desert scrub
Low rainfall - acacia senegal savanna
Savanna woodland - combretum cordofanum - albizzia sericocephela

Source: Sudan Survey Dept., Khartoum (1983)

Figure 2.11 Vegetation of East Darfur

2.7 Water Supply

Groundwater is considered to be the most important source of water in areas which have a poor supply of surface water. Rodis et al. (1963), emphasized the role of ground water in Kordofan region where there is a large animal and human population, and agriculture is widespread.

Boreholes cover most areas where the Nubian sandstone and Um Rowaba formation are found. Of the 451 boreholes drilled in E. Kordofan up to 1983 only 285 were successful. The majority of the boreholes (309) were drilled between 1969 and 1983, of which approximately two thirds (200) were successful (Table 2.4). The majority of boreholes were drilled in the late 1960s and during the 1970s in response to the government encouraging the people to participate in an "anti-thirst campaign" through a self-help programme (Figure 2.12).

Similarly, of the 100 boreholes drilled in E. Darfur up to 1983 only 49 boreholes were successful, however, 26.5% of the successful boreholes were drilled in the 1950s and before that. The majority of the successful boreholes (63.3%) were drilled during the 1960s and only 10.2% during 1970s (Figure 2.13).

There are 67 shallow wells in E. Kordofan the majority of them being located in the northwestern corner and some in the southwestern part. Their depths vary between 14 m (Shirkala) and 69.5 m (Shubola), and the average is 30.5 - 36.6 m. About 25 shallow wells are found in E. Darfur, most of them are located in Um Kaddada Rural Council and vary in depth between 36.6 m and 64 m (Um Talateen). In times of break-down of the borehole system people use these shallow wells (Plate 2.1). A major problem is facing many of E. Kordofan wells now as in recent years most of these wells went dry.

In areas of Basement Complex hafirs[1] are the main source of water supply. There are 17 hafirs in E. Kordofan situated in the clay soil of the south-western corner of the region. Their capacities range between 7,000 gallons (Al Tagato) and 40,000 gallons (Al Gafil). Despite the fact that there were many hafirs, people are continuing to have great difficulty

---

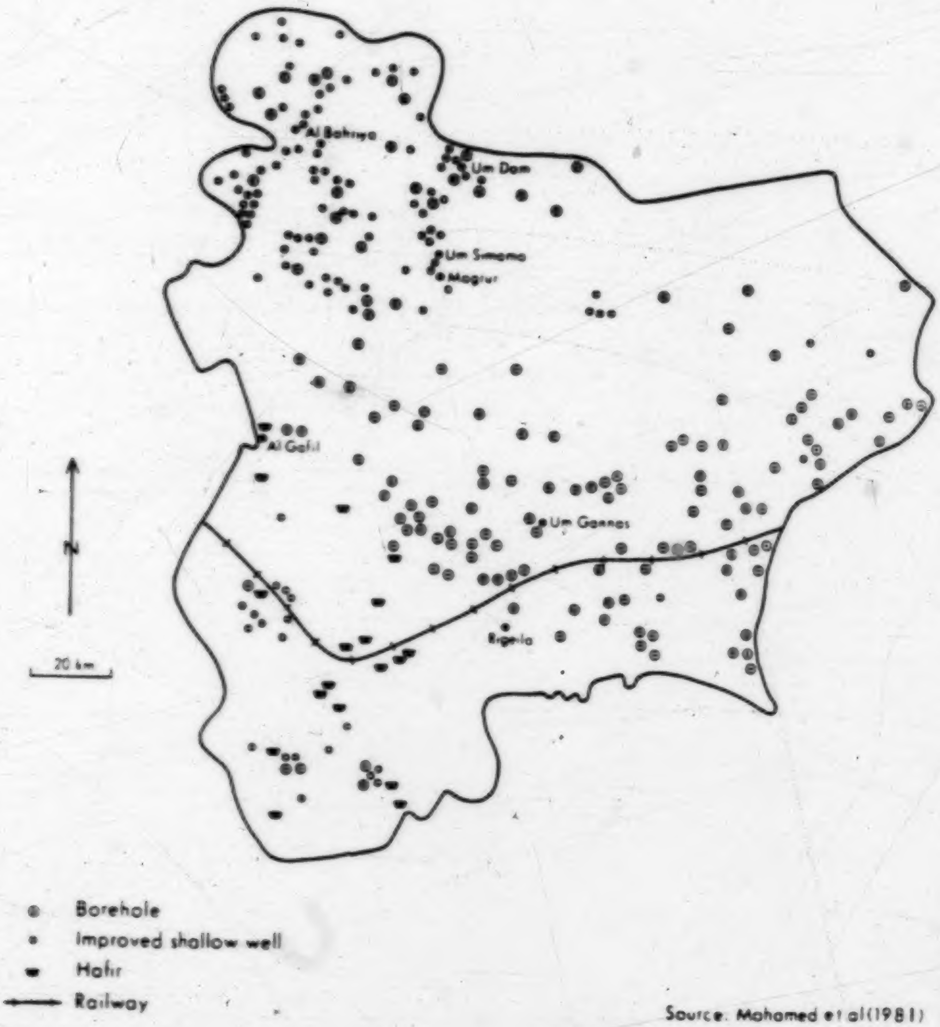
[1] Hafir = An artificially excavated surface reservoir.

TABLE 2.4

Sources of water supply in the study area

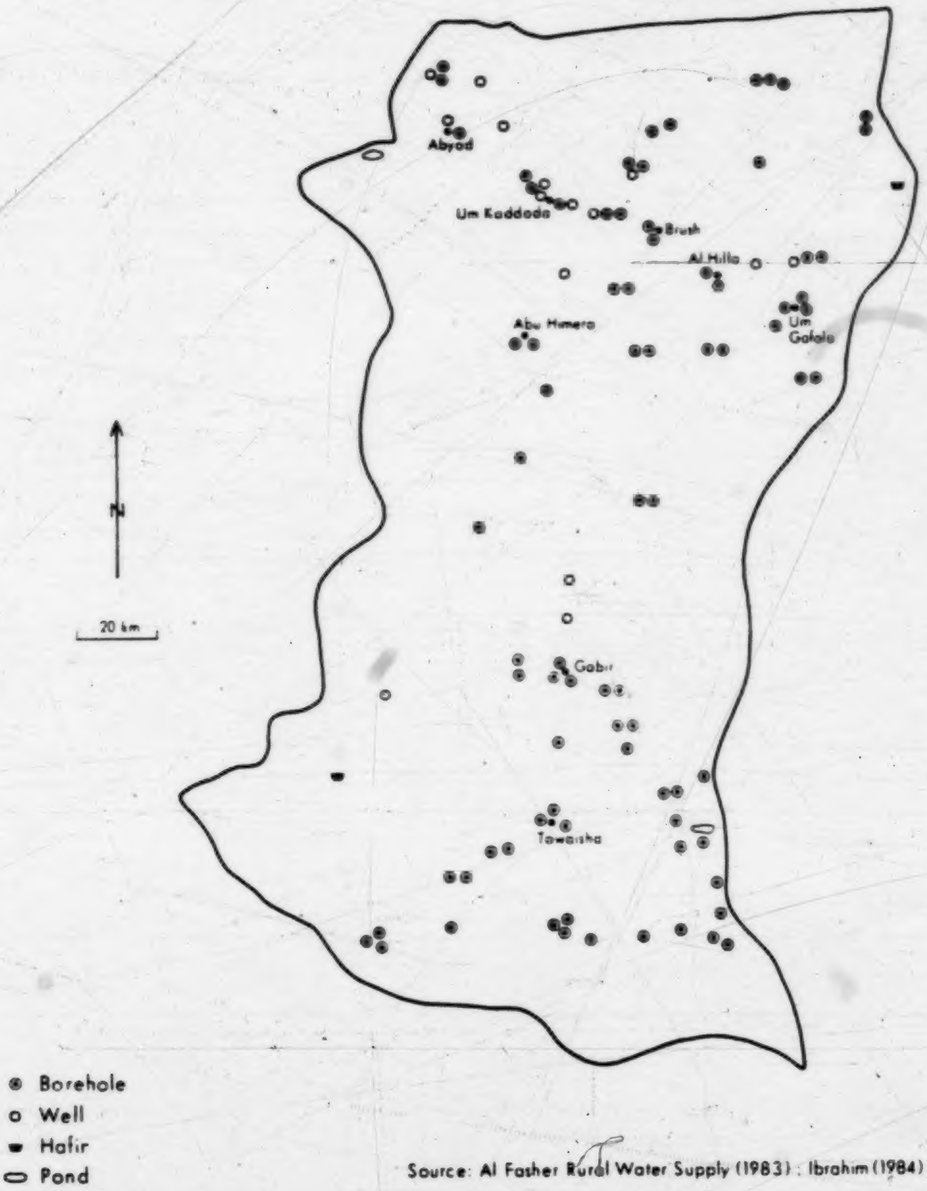
Region	Boreholes	Shallow wells	Hafirs, Ponds and Dams
E. Kordofan	451	67	17
E. Darfur	100	25	2

Source: Dept. of Rural Water Supply in Khartoum, Al Obeid and Al Fasher (1983)


Al Bahriya
Um Dam
Um Simama
Magrur
Al Galil
Um Gannas
Rigeila
N
20 km
Borehole
Improved shallow well
Hafir
Railway

Source: Mohamed et al(1981)

Figure 2.12 Distribution of water yards in East Kordofan


Abyad
Um Kaddada
Brush
Al Hilla
Um Gafala
Abu Himera
Gabir
Tawaisha
N
20 km
● Borehole
○ Well
▬ Hafir
⬭ Pond

Source: Al Fasher Rural Water Supply (1983) ; Ibrahim (1984)

Figure 2.13 Sources of water supply in East Darfur

Plate 2.1 The subsurface well of Al Arais village in E. Darfur

obtaining water. Because of drought they serve more people than their capacities allow, especially during the summer when many of the nomadic tribes migrated southward. For example, even though a large hafir exists, great difficulty still occurs during the summer. Water must be transported from Er Rahad and this is sold at a very high price (one tin which equals 4 gallons was sold for one Sudanese pound)

Ponds (***Turdas*, *Fulas*** and ***Rihud***) are scattered throughout the southern part of E. Kordofan. They are filled with water during the rainy season and provide the local people with water for some time after the rainy season. Some such as Er Rahad are big and sustain water the year round.

2.8 Conclusion

The main features of the physical environments include the resources provided by the environment to both farmers and nomads, such as land, water and vegetation. However, these resources have undergone continuous changes, especially during recent years, due to natural and human interference with the environment.

The changes include: (1) land degradation through the process of drought and desertification; For example, Lampary (1975) discovered that the southern limit of the desert has extended 90 to 100 km further south since 1958. His findings suggest that the Sahara moves approximately 6 km every year. (2) changes in the ecological zones; (3) the disappearance of many plant species; and (4) the depletion of many water sources. Unfortunately, these changes were not favourable to resource users (farmers and nomads). The farmers and nomads therefore, will have to adjust not only to drought, but also to the new environment created by nature and human misuse of natural resources.

Chapter 3

Methodology

This chapter discusses the data collection procedure and will be discussed under the following sub-headings : sources of information, duration of the field work, questionnaire design and administration, and sampling procedure, informal interviews and observation, other sources of information, data analysis and manipulation, and problems encountered.

3.1 Sources of information:

Data were primarily collected from interviews with farmers, nomads and government officials, informal interviews, observation and personal communication. In addition, a review of newspaper articles, magazines, conference proceedings, relevant government documents and photographs were used as secondary sources.

3.2 Duration of the field work:

The field work was conducted in a 10 month period, between January and October 1983. Four months of this period were spent in the study area, May and June in E. Darfur, July and August in E. Kordofan.

This period was chosen in order to ensure that the peasant farmers would be available at their villages. This marks the beginning of the agricultural season for the majority of the peasant farmers. Similarly, it was the period when the pastoral nomads of E. Darfur and those from nearby were available around water points (*damers*) and when the Kababish and the Kawahla start moving southward into E. Darfur from the north. However, the situation was different in E. Kordofan as the nomads tended to be away from the water points in July and August and therefore the technique of conducting interviews with them was modified.

The remaining six months of the field period were spent reviewing relevant government documents, preparing for the field trip, reviewing newspapers articles, magazines and attending a conference on desertification.

3.3 Questionnaire design, administration and sampling procedure

A questionnaire was designed for each group, the farmers, nomads and government officials (Appendices 1, 2 and 3). The majority of the questions were open-ended. This approach was thought to be the most useful in order to fulfil the objectives of the study. Open-ended questions allow respondents to answer more freely and in this way more accurately reflect their opinions and views. They also allow the respondents to make more spontaneous comments that can provide deeper insights into the respondents attitudes, views and opinions. A major disadvantage of this approach is that it is difficult and time consuming to code the responses to open-ended questions for computer-assisted analysis.

The questionnaires were written in English, and translated into Arabic when administered, and the answers were recorded in Arabic.

The peasant farmers and the pastoral nomads' questionnaires were administered by the author with the help of three interviewers, one in E. Darfur and two in E. Kordofan; the government officials' questionnaire was administered by the author alone.

Although the government officials survey was designed to be self-administered about 90% of them were administered by the author personally so as to gain some insight into the problems and planning aspects of the study area in particular and in Kordofan and Darfur regions in general.

Interviews were conducted with the peasant farmers in the early morning, at noon and in the late afternoon when peasant farmers were available in the villages. Interviews with the pastoral nomads were conducted in the mornings in E. Darfur when the nomads were available at water points. In E. Kordofan interviews with the nomads were conducted in the animal markets in the mornings, and at noon in temporary camps and the new settlement after they returned from pastures in the late afternoon.

3.3.1 The peasant farmers

The peasant farmers' questionnaire was designed to provide information in the following areas:

1. Socio-economic characteristic of the peasant farmers.
2. Aspects of awareness, experience, signs and perception of drought as well as beliefs and attitudes towards adjustment and the environment.
3. Methods of adjustment to drought. (see Appendix 1)

The questionnaire was pre-tested by distribution to a group of 20 peasant farmers from western Sudan in Tutti Island, Khartoum. As a result of the pre-testing two questions were removed from the survey as they were found to overlap.

Initially it was decided that between 10% and 15% of the central villages in each region were to be sampled on a random basis and interviews were to be conducted with 25% of the households in each village. After examining the results of the 1983 (Feb.) census in E. Darfur, it was found that number of households in the central villages[1] ranged between 5 (Al Higair Al Azrag) and 500 (Abu Himera) in Um Kaddada R.C. The number reached up to 1200 households (Haskanita) in Al Ayit R.C. in the south.

During the field trip (May-June 1983) it was found that the situation had changed. Some villages had lost a sizable number of their inhabitants (Al Dikheiry 1983), and others were uninhabited (Table 3.1).

---

[1] A village that acts as a core to other smaller villages.

TABLE 3.1
Number of households at selected villages in
Um Kaddada R.C. during the field trip (1983)

Name of village	No. of household during 1983 census (Feb.)	No. of households during field trip (May-June 1983)
Abyad	17	7
Um Talateen	17	10
Al Rutrut	50	12
Al Hilla	86	17
Um Sidra (Tubluk)	200	40
Brush	300	30
Abu Himara	500	20
Al Higair Al Azrag	5	0

According to the 1983 census there were 67 central villages in E. Darfur. If 10%-15% villages were surveyed the total number of sample.sites would only be nine, about five in Um Kaddada R.C. and four in Al Ayit R.C. this number was considered unappropriate as it does not reflect the true situation. The number of respondents would be small, thus increasing the sampling error and narrowing the chance for external validity.

The number of sample sites was increased and interviews were conducted in 25.4% of the central villages of E. Darfur 10 in Um Kaddada R.C. and seven in Al Ayit R.C. (Table 3.2) and Figure (3.1). It should be mentioned that most of Al Ayit R.C. lies in the savanna zone. Although it should not be included in this study because it is not part of the semi-arid areas, it was thought that it would be useful to include it in the sample. This will show the extent to which the region was affected by drought, and enable some comparison between the two parts of E. Darfur (Um Kaddada and Al Ayit R.Cs.)

In E. Kordofan, the situation was different. By the time of the field trip (July-August) most peasant farmers were available at their villages. It was thought that 24 sample sites would be appropriate (Figure 3.2). This represents 4.4% of the central villages of

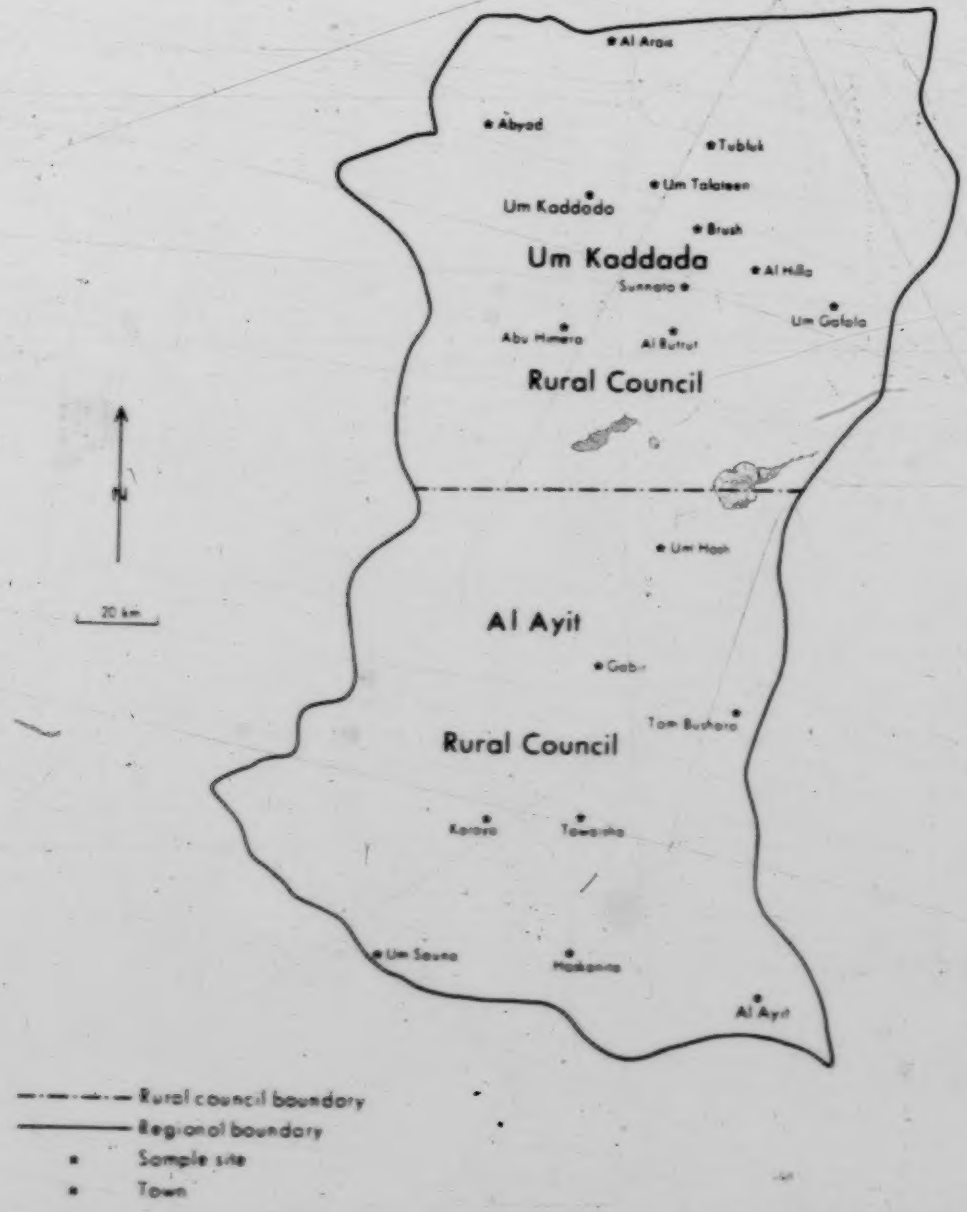
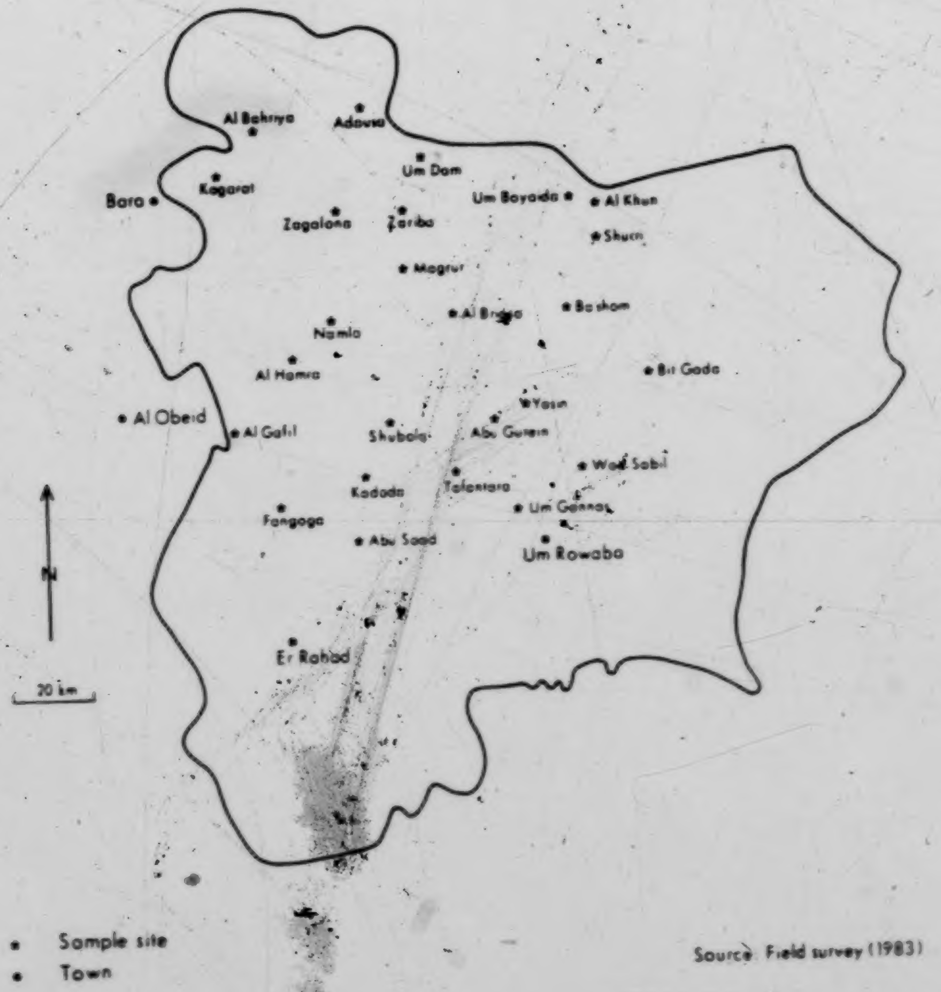

Al Araa
Abyad
Tubluk
Um Talateen
Um Kaddada
Brush
Um Kaddada
Al Hilla
Sunnata
Um Galala
Abu Himera
Al Rutrut
Rural Council
N
20 km
Um Hash
Al Ayit
Gabir
Tom Bushara
Rural Council
Karaba
Tawaisha
Um Sauna
Haskanita
Al Ayit
Rural council boundary
Regional boundary
Sample site
Town

Figure 3.1 Sample sites of peasant farmers in East Darfur


Al Bahriya
Adawsa
Um Dam
Bara
Kagarat
Um Boyaida
Al Khun
Zagalona
Zariba
Shuen
Magrur
Al Brdga
Basham
Namla
Al Hamra
Bir Gada
Yasin
Al Obeid
Al Gafil
Shubala
Abu Gurein
Wad Sabil
Kadada
Talentara
Um Gennas
Fangoga
Abu Saad
Um Rowaba
Er Rahad
N
20 km
Sample site
Town

Source: Field survey (1983)

Figure 3.2 Sample sites for peasant farmers in East Kordofan

the four sampled rural councils of E. Kordofan (Table 3.2).

The sample sites were chosen from the 1:250,000 scale maps of E. Kordofan and E. Darfur in order to cover the bulk of both regions and to represent the greatest variety of environments and communities (tribes). It should be noted that the northeastern part in both regions is either thinly populated or uninhabited as is the case for most of the central and western parts of E. Darfur.

The initial approach for sampling the peasant farmers was to conduct interviews with 25% of the households at each sample site. During the field trip it was found that it was very difficult to carry out this approach due to the absence of many householders in each village (Table 3.1). Consequently, in each sample site people were asked about the actual number of households available at that time.[2] Interviews were then conducted with the majority of those who were available if not all as in the case of Abyad and Um Talateen in E. Darfur and Adosa, Al Khun, Bashom, Yasin and Abu Gurein in E. Kordofan. The number of respondents totaled 266 in E. Kordofan and 178 in E. Darfur (Appendices 4 and 5). According to the 1983 census, these samples represent 0.3% and 0.8% of the total number of households respectively. The average time spent in each sample site was one day.

3.3.2 The pastoral nomads

The questionnaire administered to the pastoral nomads was designed in part to collect the same information as that sought from the peasant farmers (Appendix 2). However, it was not possible to interview both farmers and nomads using one questionnaire, because their specific adjustments to drought were not the same, therefore, a separate questionnaire was justified.

The information that was collected deals with the socio-economic characteristics of the nomads, the nomads' perception of drought, their attitudes and beliefs towards the adjustment to drought and the environment in general. This questionnaire was also pre-tested among some migrants from western Sudan in Tutti Island.

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[2] Available in the village during one month before field trip.

At first it was decided that between six and 10 sample sites would be randomly chosen in each region in which interviews would be conducted with the pastoral nomads. 10 sample sites were chosen in E. Darfur. In two of them only group interviews were conducted (Figure 3.3). Sample sites were chosen along the migratory routes of the Kababish and the Kawahla on their journey southward; also in areas where other tribes entered E. Darfur such as Zayadia and Tungor who had access to the Abyad, Um Kaddada and Um Hosh water points and the Hamar who have access to water points in Towaisha and Haskanita, and Abu Sifyan in the south. All interviews in E. Darfur were conducted around water points. Similar to the peasant farmers survey; a rigorous sampling procedure was impossible because nomads are a mobile society and the number of nomads who used these water points was unknown. The author[3] conducted interviews with the nomads who entered water points from the early morning until late afternoon. The unit of investigation was the household. Interviews were conducted with 96 pastoral nomads in E. Darfur (Appendix 6)

In E. Kordofan interviews were conducted with the nomads in 11 sample sites (Figure 3.4). Unlike E. Darfur interviews were conducted at weekly animal markets, temporary camps and in areas where nomads were newly settled (voluntary settlement). This is because by the time the field trip was conducted (July and August) the nomads were away from water points as it was the rainy season. In nomad camps and new settlements interviews were conducted with all the available households. In the weekly markets interviews were conducted with any responsive respondents. It should be mentioned that due to the much appreciated help of the Shanabla chief "Mohamed Al Muna" we were able to conduct interviews with all of the available Shanabla in the various sample sites of E. Kordofan. This encouraged other respondents from different tribes to be more co-operative with the interviewers. One great advantage of the weekly market interviews was that it increased the diversity of the sample, since different tribes patronized these markets. One major disadvantage of market interviews

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[3] All interviews with the nomads in E. Darfur were conducted by the author.

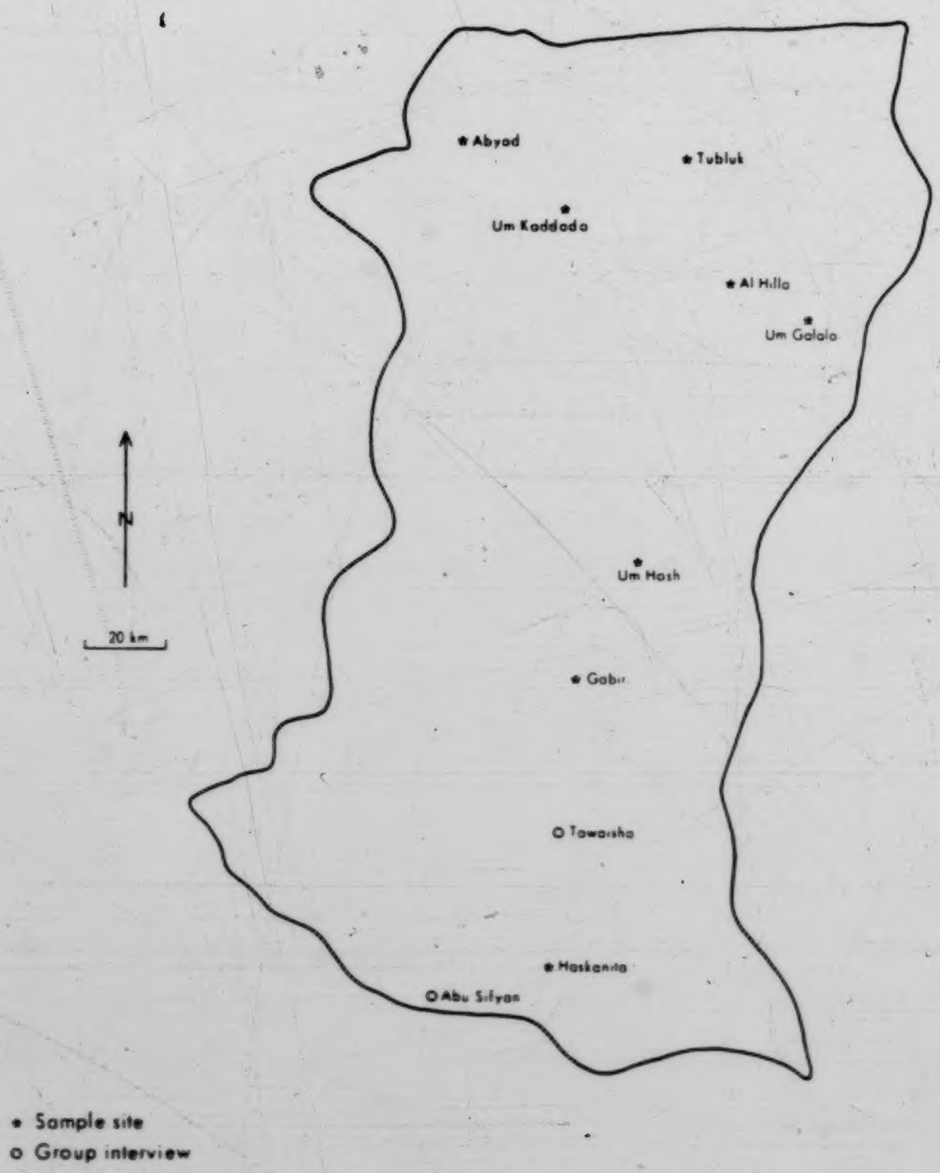
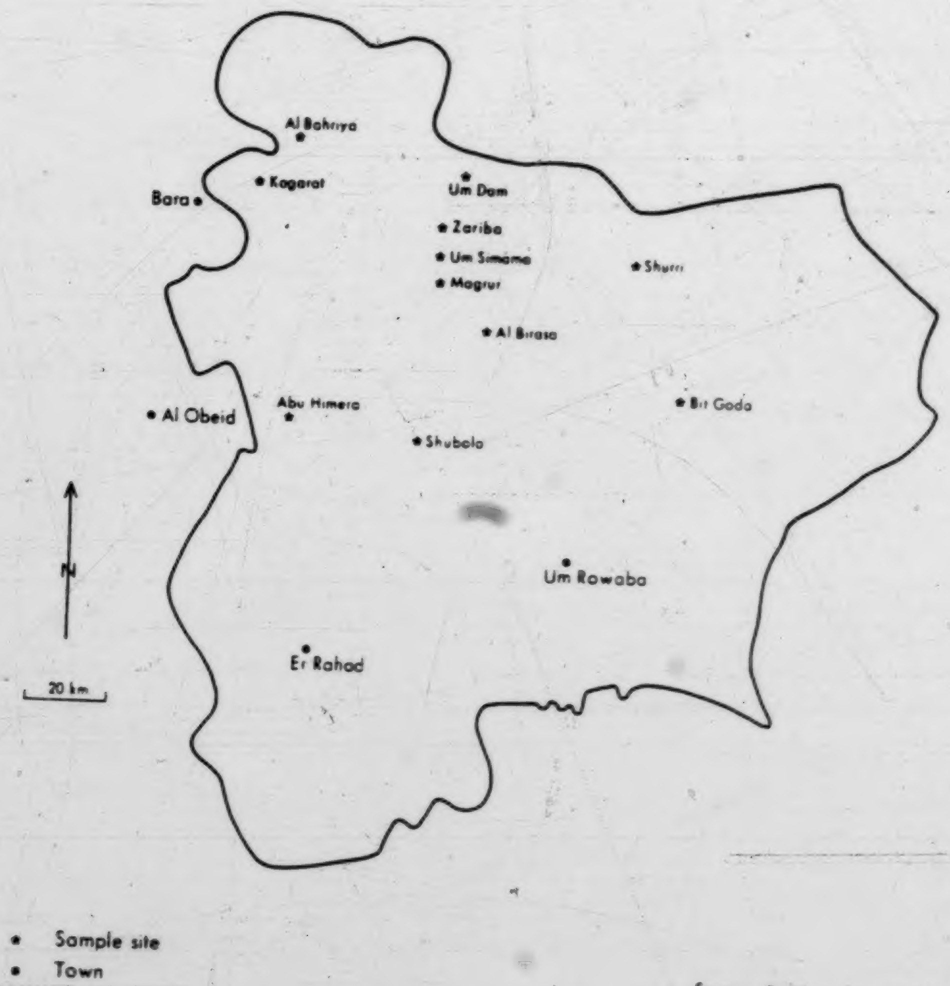

Abyad
Tubluk
Um Kaddada
Al Hilla
Um Galala
N
Um Hash
20 km
Gabir
Tawaisha
Haskanita
Abu Sifyan
* Sample site
o Group interview

Figure 3.3 Sample sites for pastoral nomads in East Darfur


Al Bahriya
Kagarat
Um Dam
Bara
Zariba
Um Simama
Magrur
Shurri
Al Birasa
Abu Himera
Al Obeid
Bir Goda
Shubola
N
Um Rowaba
Er Rahad
20 km
* Sample site
• Town

Source: Field survey (1983)

Figure 3.4 Sample sites for pastoral nomads in East Kordofan

was that interviewers did not have access to the numbers of animals owned by nomads.

In some instances interviews conducted with the nomads took an informal form. Respondents were asked questions without recording the answers immediately in front of them. However, the format of the interview depended on the mood of the respondents and the perception of interviewers with regard to the degree of responsiveness of the respondents.

The pastoral nomads questionnaire was designed to be administrated beside water points "*damers*", in the summer. Since the approach was changed in E. Kordofan (interviews conducted in the rainy season away from water points), minor changes in the wording of the questions concerning the period of the "*damers*" took place. First, a new question was added (16A) "Where did you spend the summer?" Second, the words "come" and "here" in the questions 17, 18, 19 and 20 were replaced by "go" and "there". Therefore, it read "go there" instead of "come here". Question 21 was changed and read "How long did you stay there?" The rest of the questions remained the same (Appendix 2). Interviews were conducted with 112 pastoral nomads in E. Kordofan. This increased the number of nomad respondents in both regions to 208 respondents.

Finally, conducting interviews with the pastoral nomads is not an easy job. It needs patience, flexibility and highly trained interviewers. For this reason all interviews with the nomads in E. Darfur were conducted by the author himself.

Many of the problems faced by interviewers were solved on the spot. A meeting was held with interviewers each night to solve the problems encountered and to record their observations about people, animals and the environment.

3.3.3 The government officials:

By virtue of their positions, government officials are supposed to take an active part in the adjustment to drought. Their questionnaire was divided into two parts. Part 1 was designed to reveal information about the socio-economic characteristics of the government officials. Part 2 was intended to reveal some information about awareness and perception of and adjustment to drought hazard. The main purpose behind this was to compare the perception of policy makers (government officials) and resource users (farmers and nomads) (Appendix 3). The questionnaire was pre-tested among a group of nine government officials at Khartoum.

It was thought appropriate to conduct interviews with government officials at two levels, regional H.Qs. and district and rural council H.Qs., or important administrative central villages. Al Fasher and Al Obeid, therefore, were chosen to represent the regional sample sites. Um Rowaba, Er Rahad and Abu Saad sample sites in E. Kordofan and Um Kaddada and Al Ayit in E. Darfur represented the second level. There were seven sample sites in all (Appendix 7).

Interviews were conducted with respondents in three major areas; agricultural and animal resources administration, water resources administrations and local government officers. These units were believed to have a direct contact and influence on the farmers and nomads life. The units of investigation were the heads of the sub-departments in each area because this was considered more representative. The total number was 50 respondents, 31 respondents in E. Kordofan and 19 in E. Darfur. Thus the total number of respondents (farmers, nomads and government officials) was 702 (Table 3.3).

3.4 Informal interviews and observation

Both informal interviews and observation were used to supplement information revealed by the questionnaires. Informal interviews were conducted at individual as well as group levels. They were conducted with some farmers who came from nearby and from distant locations which were not covered by the sample sites. Information collected in this way was not analysed, it was only referred to in certain places. It was hoped that this information would increase our understanding with regard to the different parts of the region.

Informal interviews were conducted with nomads and individuals who dealt with nomads such as teachers, local leaders, merchants and animal traders. They revealed some information about the way of life of the nomads, recent changes in their life and their

TABLE 3.2

Peasant farmers sampled villages

Region	Total No. of R.C. in each region	No. of R.C. represented by sample sites	Total No. of central villages	No. of sampled central villages "sample sites"	% of sample sites in relation to total no. of Central villages
E. Kordofan	5	4 "Um Dam, ErRahad UmRowaba Ashana"	542	24	4.4
E. Darfur	2	2 "Um Kaddada Al Ayit"	67	17	25.4
Total	7	6	609	41	6.7

TABLE 3.3

The total number of respondents in the study area

Region	Peasant farmers	Pastoral nomads	Govt. officials	Total
E. Kordofan	266	112	31	409
E. Darfur	178	96	19	293
Total	444	208	50	702

relationship with settlers. It was observed that both farmers and nomads tended to talk about problems such as problems of water supply, high prices of grain and lack of social services. Informal interviews with government officials tended to focus on the problems of the regions, the plans set up to solve them and problems facing implementation of plans.

Observation, on the other hand, proved to be useful with both farmers and nomads. Two observation sheets were prepared for this purpose. That prepared for study of the nomads was cancelled after it became obvious that it could not be applied, because the information sought could not be obtained under the field circumstances. Only village observation was used in order to provide information about the physical environment, social services, transportation, prices of crops for five years (1978-82) and years of past drought and famines (Appendix 8). Some of the information on village observation was gathered through group interviews with elderly peasant farmers especially that pertaining to past drought and famines. This information is presented in Chapter (5). Observation proved to be very useful in terms of the number of animals owned by individuals especially the pastoral nomads.

3.5 Other sources of information

Other information was gathered through a review of relevant government documents. These documents include : the population census, agricultural statistics, meteorological, and historical records.

Newspapers and magazine articles that dealt with drought and desertification were reviewed. They proved to be very helpful, especially Sudanese newspapers (Al Ayam and Al Sahafa daily newspapers.) which covered most incidents of the severe drought of 1984. Personal communication was also considered as an important means of data collection, since very little has been written about the effect of drought (i.e. changes in social and physical environments).

Attending regional development conferences or obtaining unpublished conference papers on desertification and agriculture have further enriched the study.

3.6 Data analysis and manipulation

The data resulting from the three questionnaires were analyised using the SPSSX computer programme. The first statistical method used in the analysis of the data was simple frequency distribution. After the data were adjusted a cross-tabulation sub-programme was used to show the strength of association between various dependent and independent variables. Cross-tabulation was useful in showing the trend of the data and presenting them for scrutiny. It was not possible to apply cross-tabulation to some of the data using chi-square because data were presented in a multi-response form. In some of these cross-tabulations the expected number of counts in some cells was less than one (zero), thus the significance level became invalid. Such results were considered only to show the trend of the data.

The 0.05 level of significance was utilized to determine the statistical significance of association between variables. If the level was less than 0.05, the difference was considered as significant. Some of the data collected through village observation were manually quantified.

3.7 Problems encountered

It was expected that many problems would be faced during the field work; these were:

1. There were no meteorological records for the vast majority of villages in the study area. Some of the records concerning adjacent villages were incomplete especially for the period (1978-82).
2. Records of crop yields especially food crops such as ***dukhn*** (millet) and ***dura*** (sorghum) were not available in both regions. The only available records were those for cash crops sold at crop markets such as Um Rowaba and Al Obeid markets.
3. Updated maps of districts or rural councils were not available. The last published maps were designed in the 1940s. Since then many changes have taken place especially in the semi-arid areas where many villages change location or have appeared only recently. For example, Al Ayit has recently emerged as an important town in E. Darfur, yet it did not appear on many maps.

4. At some sample sites local leaders tried to influence the sample and make it biased towards the rich. They were told interviews should be conducted with all segments of the farmers society in order to be more representative.

5. Both farmers and nomads tended to answer the question of how many animals they owned incorrectly. They understated the number of animals they had. El Arifi (1983) stated that any number given by respondents of both groups should be multiplied by four to give true figure. It was clear that they were afraid of paying more tax and the "evil eye".

6. Similarly, both peasant farmers and pastoral nomads were hiding the true number of their families and their age. Instead some gave a range. In this case interviewers calculated the average and recorded it.

7. One major problem encountered with the nomads was that they were often not responsive to the interviewers. They either referred interviewers to the chief or to someone else. First, they thought interviewers were tax collectors. Second, some tribes were in dispute and some of the nomads thought interviewers belonged to rural tribes or would like to take information to support the other tribes in conflicts. They advanced such comments as:

> "I do not know how to read or write, go and ask those who read and write."
>
> "Your questions will bring us nothing. We were asked so many times before and nothing has been given to us"
>
> "What does the government want to do with these questions."

8. Nomads are always suspicious and very difficult to interview. In some cases the presence of many people around a respondent made him more careful in his response and impatient. Comments like these were heard:

> "Ask my brother I am going to bring something from the market"
>
> "Wouldn't you finish your questions, I have some other things to do."

Such comments made the interviewers very upset at first, but after some explanation of the need for patience, they managed to conduct very successful interviews with nomads.

9. It was not possible to find an updated figure for the animal population in the Sudan. The last estimate was released in 1978 (Agricultural Statistics 1979).
10. Six interviews could not be conducted and the questionnaires that were left were not returned.

Despite these problems the fieldwork proved to be successful, and was greatly helped by the dedication and interest shown by the interviewers.

Chapter 4

Socio-economic characteristics and cultural adaptation to the environment by the peasant farmers and the pastoral nomads

This chapter presents the socio-economic characteristics of the peasant farmers and the pastoral nomads and their cultural adaptation to the environment. These socio-economic variables, including income, education, age, sex and family size, are considered of some importance in explaining variations in people's perception and behaviour (e.g., Jackson and Foster 1982; Kates 1970). They are used here in order to describe some of the people's characteristics.

In this study, cultural adaptation represents the pattern of life adopted by both the farmers and the nomads in response to their environment, regardless of whether there is or is not a drought.

4.1 Age and education of farmers and nomads

Slight differences were observed between ages of the peasant farmers and the pastoral nomads. The data in Table 4.1 suggest that practising agriculture and nomadism is not attractive to younger people; that is, those 30 years old or less. More than half of the farmers and 62.5% of the nomads were between 31-50 years old. It seems that elderly peasant farmers (51 years old and over) are more likely to be involved in farming activities than elderly pastoral nomads are in nomadic activities. In fact, it was found that the elderly nomads stayed in their camps without carrying out any tomadic activity.

There was a significant difference between the level of education of the peasant farmers and the pastoral nomads. Almost three-quarters of the nomads compared with 41.4% of the farmers were illiterate. The nomid's mobility means they do not have the same opportunity to attend schools. In contrast, the farmers are more educated than the nomads (Table 4.2), since presumably they can attend village schools.

TABLE 4.1

How old are you?

Age-Group	Peasant farmers		Pastoral nomads	
	N	%	N	%
<30	78	17.6	41	19.7
31 - 40	137	30.9	57	27.4
41 - 50	97	21.8	73	35.1
51 & over	132	29.7	37	17.8
Total	444	100.0	208	100.0

Chi-square = 18.253; d.f. = 3; $p < 0.0004$

TABLE 4.2

Level of education

Response	Peasant farmers		Pastoral nomads	
	N	%	N	%
Illiterate	184	41.4	149	71.6
Khalwa[1] and lit. classes	162	36.5	51	24.5
Elementary	78	17.6	6	2.9
Intermediate and more	20	4.5	2	1.0
Total	444	100.0	208	100.0

Chi-square = 60.464; d.f. = 3; $p < 0.0000$

[1] Khalwa = religious study.

4.1.1 Nomads' attitude towards education

It is evident that the pastoral nomads were the least educated compared with the farmers. There is a notion that the nomads feel reluctant to send their children to school (e.g., El Arifi 1975; Khogali 1980). To examine the extent to which these findings are true and to see whether the nomads have developed a negative attitude towards education, they were asked whether they agree or disagree with the idea of sending their children to school. The vast majority of the pastoral nomads answered that they agree with sending their children to school.

> "I didn't want them to feel the hardship that I felt."
>
> "I want them to learn in order that they may come back and have big jobs in order to help us"
>
> The author: How?
>
> "We have great difficulty in getting water and prices of grains are very high, and everything in life is becoming difficult"
>
> "I didn't go to school, I want them to go to school . . . time is changed I kept the older ones and sent the youngers to school."

In a supplementary question those who indicated agreement with sending their children to school were asked what they expected of schooling. They all indicated that they wanted their children to learn.

Those who did not agree with the idea of sending their children to school, stated that they wanted their children to work with them. One possible explanation for this is that children, like other members of the family, have tasks to do, such as looking after animals with their fathers and helping in the watering of animals. This was reflected in their comments:

> "Who is going to help me manage these animals when we go through farms?"
> "I want them to help me . . . I have no money to hire some people to look after animals."

Even among those who basically agreed to send their children to school, it was expected that the children would help during the school vacations. Assistance to the nomads also is given by those unable to continue their education. Here are some of their comments:

> "I will send them . . . the ones who succeed in the school I will let them continue. The ones who were not successful have to come and help me."
>
> "I agree sending half of them and the other half must work with me"

The portion of the nomads who were reluctant to send their children to school were only 15% of the respondents, whereas the vast majority of the pastoral nomads (85.0%) were willing to send their children to school. This result indicates that pastoral nomads have developed a positive attitude towards education. A change such as this could be utilized by planners and interested individuals in the formulation of a sound developmental plan for the betterment of nomadic life. This could be carried out through the provision of education to the nomads, especially education which has some relevance to the nomads' mode of life.

4.2 The peasant farmers' other socio-economic characteristics and their cultural adaptation to the environment

For more than half of the peasant farmers (53.8%) the family size was between seven and 12 persons, and 7.9% had a family size of 13 persons and over.

When asked how long they had been farming in the area, 30.4% of farmers mentioned they had practised agriculture in the area for 20 years or less. Thirty-seven percent had practised agriculture for a period of between 20 and 30 years. The above results indicate that the majority of the peasant farmers were resident in their place of farming for 30 years and less.

There might be a close relationship between the place of farming and farm ownership. Land is considered one of the most important factors of production (Thirlwall 1978); to own land meant to have wealth, power, and prestige. Farmers were asked whether they were owners, partners or managers of their farms. In the majority of cases, the peasant farmers owned their farms. This result, would explain why the majority of the people were farming at one place for 30 years, which was clear from their spontaneous comments:

"This land is absolutely mine."

"No one is sharing the ownership of this farm."

"(*Hagati Bardah*) I enjoy the right of ownership over this land."

However, 5.6% did answer that they were partners. The system of partnership is widely used in Al Ayit rural council in E. Darfur. This system is based on the following terms: the owner of the land (in most cases a merchant) gives his partner the land, the seeds and money, and provides him with water and food. The partner cultivates and takes care of the farm until the end of the growing season. After the harvest the crops are sold, and the profit is divided equally between the two partners (the land owner and his partner).

By and large, the type of land ownership which is enjoyed by the majority of the peasant farmers is termed "*Defacto-possession*." According to the 1970 Act, the ownership of unregistered lands all over the Sudan has been transferred to the government. The inhabitants of these unregistered lands will enjoy a *usufruct* rights as long as there is a communal instead of individual ownership of the land. What is meant by the *Defacto-possession* and *usufruct* right is that the land has its origins in the customary tenure, but the community no longer has rights to it. It is not officially registered, but it is inherited, rented, and sold.

4.3 Agricultural activity

4.3.1 Crops grown

The peasant farmers cultivate varieties of crops, some mainly for food, others for cash. ***Dukhn*** (millet) and ***zenari*** or ***marag*** (sorghum) are the main staple crops cultivated for food, together with ***waka*** (okra) and ***lobia*** (***Dolichos lablab***). ***Lobia***, besides being a subsistence crop, plays another useful role as a leguminous plant by increasing the soil fertility.

Groundnuts, sesame and ***karkadi*** (***Hibiscus sabderiffa***) are cultivated as the main cash crops. Water melon used to be one of the cash crops, the seeds being sold abroad, but under the current drought condition it is cultivated instead as an additional source of water supply in early summer for both humans and animals. The gum arabic tree *Hashab* (*Acacia senegal*) constitutes an additional source of income to the peasant farmers.

4.3.2 Farm size

A set of related factors play an important role in determining the farm size. These factors include: the availability of land, the physical as well as the financial situation of the peasant farmers, the use of hired labourers, the availability of water supply, and rainfall.

The peasant farmers were asked to indicate the size of land that is cultivated by each crop. More than half of *dukhn* cultivators (53.4%) had between one and six *mukhamas* of *dukhn*[1] The vast majority of the peasant farmers cultivated relatively small farms (less than 10 *mukh.* of *dukhn*). Only 26% had more than 10 *mukh.* of *dukhn* under cultivation. Most of these farmers were from Al Ayit rural council, where the production of *dukhn* is mostly market-oriented.

Zenari and *marag* (sorghum) are the second most important staple crops. In general, the area cultivated by *zenari* is relatively small if compared with *dukhn*, sesame, groundnut and water melon. Eighteen percent of *zenari* cultivators did not cultivate *zenari* in a separate stand, but mixed it with other crops (*sifal*). Most *zenari* cultivators (38.5%) cultivated between one and three *mukh.* of *zenari*, and only 13.2% cultivated seven *mukh.* and more.

Sesame is one of the most important cash crops. It is mostly cultivated by the peasant farmers of E. Kordofan. More than three-quarters (77.7%) of sesame cultivators cultivated 10 *mukh.* of sesame and less. Like most other crops, larger sesame fields were cultivated mainly by rich peasant farmers.

Groundnuts also are an important cash crop. The majority of groundnut growers (60.8%) cultivated between one and five *mukh.* of groundnut. Few (5.9%) groundnut cultivators grew 20 *mukh.* and more. Groundnut is cultivated by the peasant farmers of E.

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[1] (one *mukhamas* = 1.73 *feddans* or 1.80 acres).

Darfur, and it was cultivated in large areas in the southern part of the region (Al Ayit R.C.).

Some 40.6% of watermelon cultivators did not cultivate watermelons in a separate stand, but mixed them with other crops. More than three-quarters of watermelon growers (76.0%) cultivated less than 10 ***mukh.*** of watermelon, and only 15.0% cultivated more than 20 ***mukh.***

The majority of ***waka*** (okra), ***lobia*** (***Dolichos lablab***) and ***karkadi*** (***Hibiscus sabderiffa***) growers cultivated these crops, on small size farms and mixed with other crops.

The majority of the peasant farmers in the study area cultivated small size farms, in comparison with the mechanized schemes (rainfed cultivation), at Al Gadarif and Habila where the average farm size is 1000 feddan (420 hectares, 578 ***mukh.***) (Agabawi 1968; Saeed 1976). Only few peasant farmers in the study area have large-sized farms (50 - 100 ***mukh.***).

4.3.3 Agricultural calendar

The farmers were asked when they began to prepare for a new agricultural season. Two-thirds of the respondents (67.2%) answered that they prepared themselves in April and May. There are two possible reasons for this: first, these are the months that preceed the beginning of the rainy season, second, most of the peasant farmers, especially during the recurrent drought, leave their farms and seek work somewhere elsewhere, returning to their villages in April and May.

Usually, peasant farmers prepare for cultivation by clearing and cleaning the land, called "***Musoga.***" The preparation for a new agricultural season depends on three factors: first, whether or not the peasant farmer is in his village; second, whether he is employed at the time; and third, on the date of the beginning of the rainy season. The rainy season starts as early as May in the most southern parts of the study area (El Tom 1975). However, cleaning of an old farm, "***saraya***", does not need as much time and effort as a newly opened one, "***bor***" (fallow land).

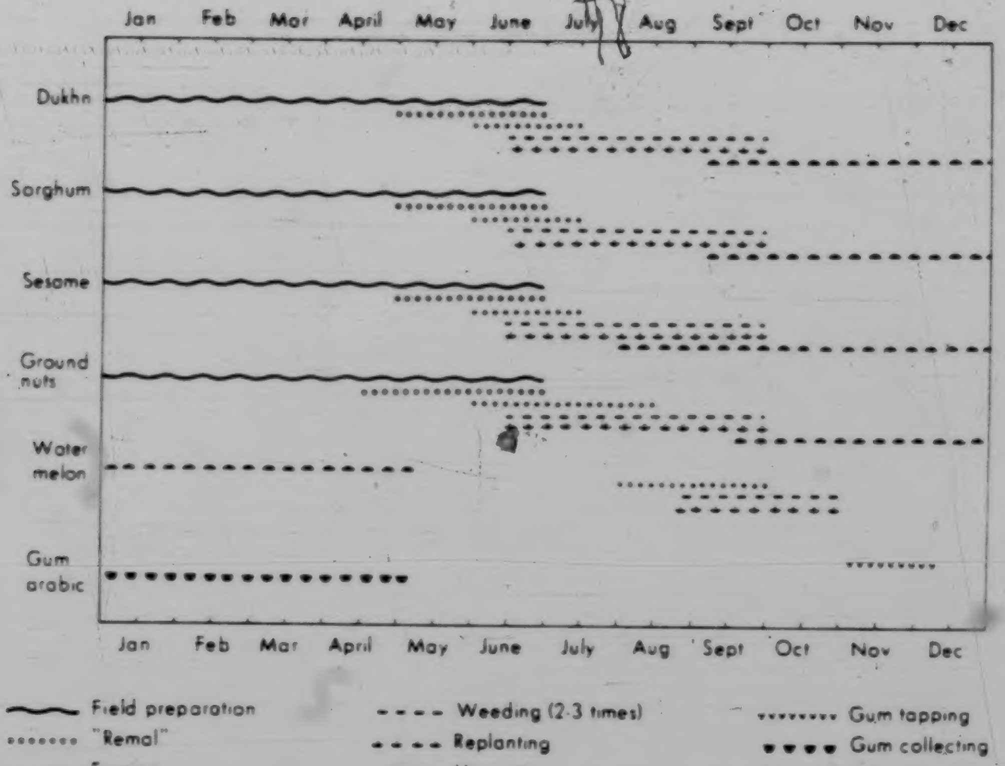
R

Information about the following agricultural activities was collected from the field through group interviews with the peasant farmers in selected villages. Having cleaned their lands some of the peasant farmers would plant before the rains. This practice is known as the "*remal*." The earliest date for the start of the "*remal*" is mid-April (Figure 4.1), but it may be as late as the beginning of July. The "*remal*" does not take more than few days, but because the beginning of the rainy season varies between the northern and the southern parts of the study area, the "*remal*" starts earlier in the southern part, especially for groundnuts, and later in the northern sections. Sowing of seeds generally starts by the beginning of June in the southern parts, and lasts until mid-July for most of the crops in northern areas, and until mid-August for groundnuts. Sowing of watermelon starts around the beginning of August and continues until the beginning of October. In some cases, watermelons are cultivated after the harvesting of sesame.

Weeding follows the sowing of crops. Plants generally are weeded twice per season, but in a few cases it may be more than that. Weeding starts one or two weeks after sowing, and lasts for three and a half months (for watermelon this is from the end of August until the end of October). The first weeding is always the hardest, and is known locally as "*Al Mor*" (the bitterness). The second one is called "*Ginkab*," which is easier than the first one. Weeding and replanting start about the same time and last for the same period. Although replanting generally occurs after weeding, some peasant farmers replant before weeding. It depends upon the personal judgement of the individual peasant farmer and his circumstances.

Harvesting starts early with sesame at the end of July, and lasts until mid-November. For crops other than watermelon and gum arabic, harvesting starts at the beginning of August and lasts until the end of December. For both watermelon and gum arabic, harvesting begins at the beginning of January and lasts until the first days of May.

The agricultural calendar reveals that the peasant farmers are kept busy the whole year round. The busiest period of the year is from May until the end of October, when most of the agricultural activity is undertaken, except for the clearing of land and the harvesting of crops.



Source Field survey (1983)

Figure 4.1 General outlines of the peasant farmers' agricultural calendar

4.3.4 Crop rotation

Crop rotation as opposed to shifting cultivation forms the basis of agricultural production in the semi-arid areas of the Sudan. As mentioned earlier, the fertility of the sandy soil (*Goz*) is low, therefore the peasant farmers increase the soil fertility by using crop rotation. In many areas, where there is no pressure for use of the land area, the peasant farmers use the fallow system, which allows the land to rest for some years. This practice is known locally as "*bor*". Fallow land (*bor*) either can be cultivated with *Hashab* (Acacia senegal), or left empty. Another system of fallow used by the farmers is cultivating legumes like *lobia*, which Silberfein (1977) called rotational planted fallow.

4.3.5 Use of hired labourers

Farmers were asked whether they use hired labourers. More than half of the respondents answered "No." This result may indicate that most peasant farmers use their own family as labourers to cultivate their farm. They use simple hand tools such as the hoe and the "*suluka*" (Plate 4.1). Those who used hired labourers were asked whether they used them on a part-time or a full-time basis. More than half (56.0%) answered that they used hired labourers as part-time help, and 44.0% as full-time help. Users of hired labourers were further asked to point out the purposes for using this hired labour. Most of the farmers (48.2%) used them to carry out all agricultural operations. Some 33.5% of those who used hired labourers used them for weeding, and 13.6% used them both for cleaning and weeding.

One-fifth (20.7%) of all peasant farmers depend entirely upon hired labourers in all phases of farming. This result poses the important question as to whether this portion of the peasant farmers should be considered as traditional farmers. It should be noted, however, that the sample included some old people who were true peasant farmers, but were too old to practise farming by themselves, and consequently hired labourers. On the other hand, there were some farmers who were young and wealthy and were working in business or were teaching, and they hired labourers to work for them in farming.

Plate 4.1 A farmer and his family sowing seeds using simple hand tools in E. Darfur

4.3.6 Highest single cost of farming

Another question asked of peasant farmers was "What is the highest single cost of farming in your farm?" Many of the respondents (39.9%) answered weeding. It should be mentioned that there is always a difference between the newly opened farm "*bor*," and the old farm the "*saraya*". Weeding of the "*bor*" is always more expensive than the "*saraya*" because the "*bor*" contains more weeds and it takes more time in weeding (Table 4.3). In areas where there is a lack of labourers, weeding prices tend to be very high, such as in E. Kordofan and the southern part of E. Darfur.

The majority of the peasant farmers (57.2%) complained about the high prices of seeds, particularly for those of sesame (29.7%) and *dukhn* (16.2%). Seed prices were high because of three main problems: first, wind transported material buried the seedlings, therefore they had to replant between three and five times; second, insects, rodents, or birds eat these seeds; third, because of the scarcity of grain, prices of seeds became very high and in some cases were unaffordable to many peasant farmers.

In conclusion, the highest cost of farming for the peasant farmers were for weeding and the prices of seeds, mainly sesame and *dukhn*. Apparently, weeding of a newly opened farm is much more expensive than that of an old one.

4.3.7 Other activities carried out by farmers

The keeping of animals by the peasant farmers of the semi-arid areas of the Sudan forms an essential part of traditional agriculture. The number of animals owned by the individual increases or decreases according to the individuals' financial status. These animals, which include goats, sheep, and cattle, are kept mainly to provide the peasant farmers with milk, meat, and a source of income when the need arises. Camels and donkeys are kept for transportation.

Most peasant farmers supplement their on-farm income with off-farm income. They might take jobs at their villages, or migrate to some other places. It can be concluded that the

TABLE 4.3

The cost of weeding per mukhamas in Sudanese pounds (sL) at selected villages in E. Darfur and E. Kordofan

Site	Saraya "old farm"	Bor "Newly opened farm"	Average	Region
Al Arais	5	7	6	N. part of E. Darfur
Al Hilla	4	6	5	N. part of E. Darfur
Brush	5	7	6	N. part of E. Darfur
Gabir	10	15	12.5	S. part of E. Darfur
Towaisha	12	15	13.5	S. part of E. Darfur
Huskanita	15	20	15	S. part of E. Darfur
Bashum	10	20	15	N. part of E. Kordofan
Bit Goda	10	20	15	N. part of E. Kordofan
Shubula	12	20	16	C. part of E. Kordofan
Tafantara	15	20	17.5	S. part of E. Kordofan

keeping of animals by farmers is an important part of traditional agriculture. These animals are kept for milk, meat, cash, and transportation. Moreover, off-farm income is an important addition to the on-farm income.

4.4 Other socio-economic characteristics and cultural adaptation to the environment by the nomads

These include the number of animals owned by the nomads as well as the nomads' seasonal migration and their agricultural activity.

4.4.1 Number of animals owned by the pastoral nomads

Research findings revealed that 82.2% of the nomads kept camels. The majority of camel owners (69.0%) kept between one and 50 camels, while very few (1.8%) owned more than 200.

The overwhelming majority of the pastoral nomads (91.3%) owned sheep herds (Table 4.4). Three-quarters (75.3%) of sheep owners kept 200 sheep and less, while 13.1% owned more than 300. The main reason for keeping large numbers of sheep by almost all of the nomads is that sheep can be managed easily, and they generate quick income.

About one-quarter of the pastoral nomads owned cattle and 72.7% of them owned 40 or less. Table 4.5 shows that only two-thirds of the pastoral nomads (67.3%) keep goats and it was found that three-quarters (77.1%) kept between 10 and 30 goats. Research also revealed that almost 60% of the pastoral nomads kept donkeys, with the majority of donkey owners keeping six donkeys and less.

The field survey revealed that the pastoral nomads keep different types of animals in order to satisfy different needs; first, animals are kept as a form of social prestige; second, to be sold when the need arises; third, for milk and meat; and fourth, to withstand different environmental problems and hazards. This finding concur with other studies such as Dahl and Hjort (1976) and Khogali (1980).

TABLE 4.4

Number of sheep owned by the pastoral nomads

No. of Sheep	N	% of Sample	% of responses to the question
1 - 100	86	41.3	45.3
101 - 200	57	27.4	30.0
201 - 300	22	10.6	11.6
>300	25	12.0	13.1
Total	190	91.3	100.0

TABLE 4.5

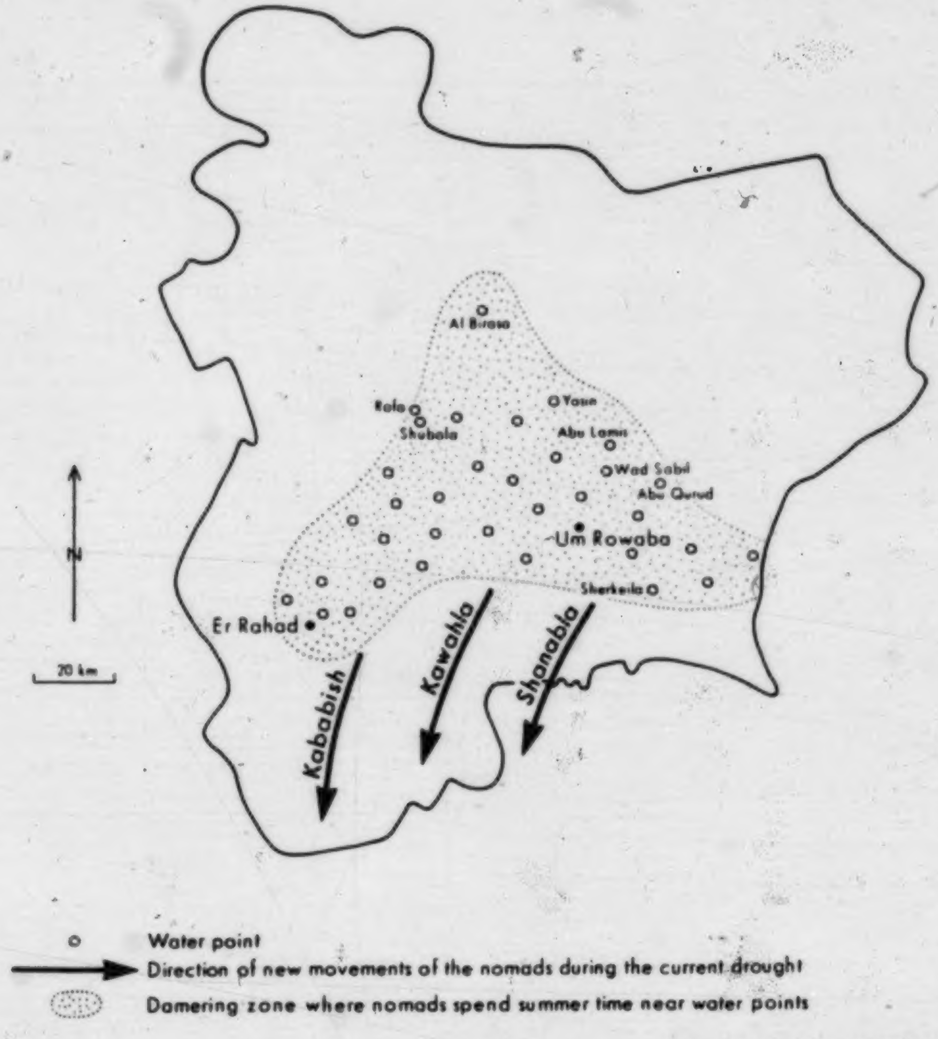
Number of goats owned by the pastoral nomads

No. of goats	N	% of Sample	% of responses to the question
<9	17	8.2	12.2
10 - 20	86	41.3	61.4
21 - 30	22	10.6	15.7
>30	15	7.2	10.7
Total	140	67.3	100

The extent to which the numbers of animals owned by the nomads is correct is unclear, since the nomads were hesitant to give the true numbers of their animals. According to El Arifi (1983), any figure that is given by the pastoral nomads with regard to animal ownership should be multiplied by four to give a true estimate of the animals owned. Based on the field survey, El Arifi's statement might be true with regard to the nomads who were interviewed in E. Kordofan, as the interviews were administered at animal markets, camps, and areas newly settled by the nomads, where it was not possible to see and verify the numbers which were reported by the pastoral nomads. In comparison, in E. Darfur interviews with the nomads were administered at water points, where animals could be seen and counted. There, it was found that the figures reported by the nomads were more or less similar to the actual numbers of animals owned.

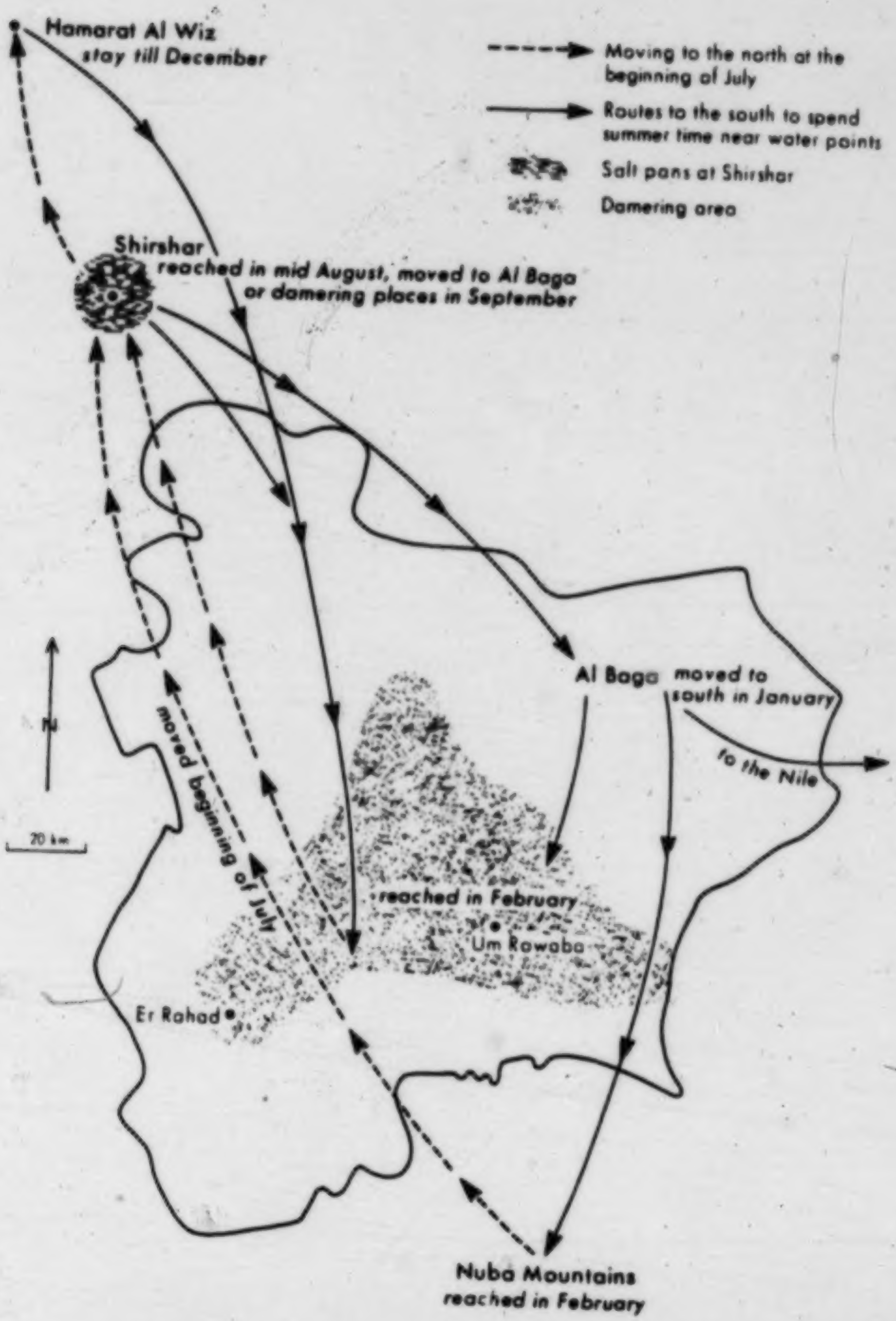
4.4.2 The seasonal migration of the nomads

Perhaps the most important single feature of adaptation to the environment by the pastoral nomads is their mobility. In general, the pastoral nomads traverse the study area in a south-to-north direction. Movement to the north starts in the beginning of the rainy season (July). In E. Kordofan, the nomads move north for three reasons; first, to move from water points, which are known locally as "*damers*" and to avoid grazing the grass around the *damers* in order to conserve it for the summer (Figure 4.2); second, towards the end of the summer (end of June) animals, especially sheep and goats, become very weak and are attacked by diseases such as *Homonchosis*. At this time the pastoral nomads move northwards to the salt pans at Shirshar in the belief that salty water will cure their weak and diseased animals (Figure 4.3). The pastoral nomads usually stay at those salt pans for a period ranging between two weeks and two months, and third, the tribes which enter the study area from the south, like the Hwazma in E. Kordofan, do so to avoid the biting flies like tse-tse flies (*Glossina morsitans*) which appear at that time.


Al Birasa
Rola
Shubala
Yasa
Abu Lamis
Wad Sabil
Abu Qurud
Um Rowaba
Sherkeila
Er Rahad
Kababish
Kawahla
Shanabla
N
20 km
Water point
Direction of new movements of the nomads during the current drought
Damering zone where nomads spend summer time near water points

Source: Field survey (1983)

Figure 4.2 Zone of the damering places and directions of the new movements of the nomads in East Kordofan


Hamarat Al Wiz
stay till December
Moving to the north at the beginning of July
Routes to the south to spend summer time near water points
Salt pans at Shirshar
Damering area
Shirshar
reached in mid August, moved to Al Baga or damering places in September
N
20 km
moved beginning of July
Al Baga
moved to south in January
to the Nile
reached in February
Um Rawaba
Er Rahad
Nuba Mountains
reached in February

Source: Field survey (1983)

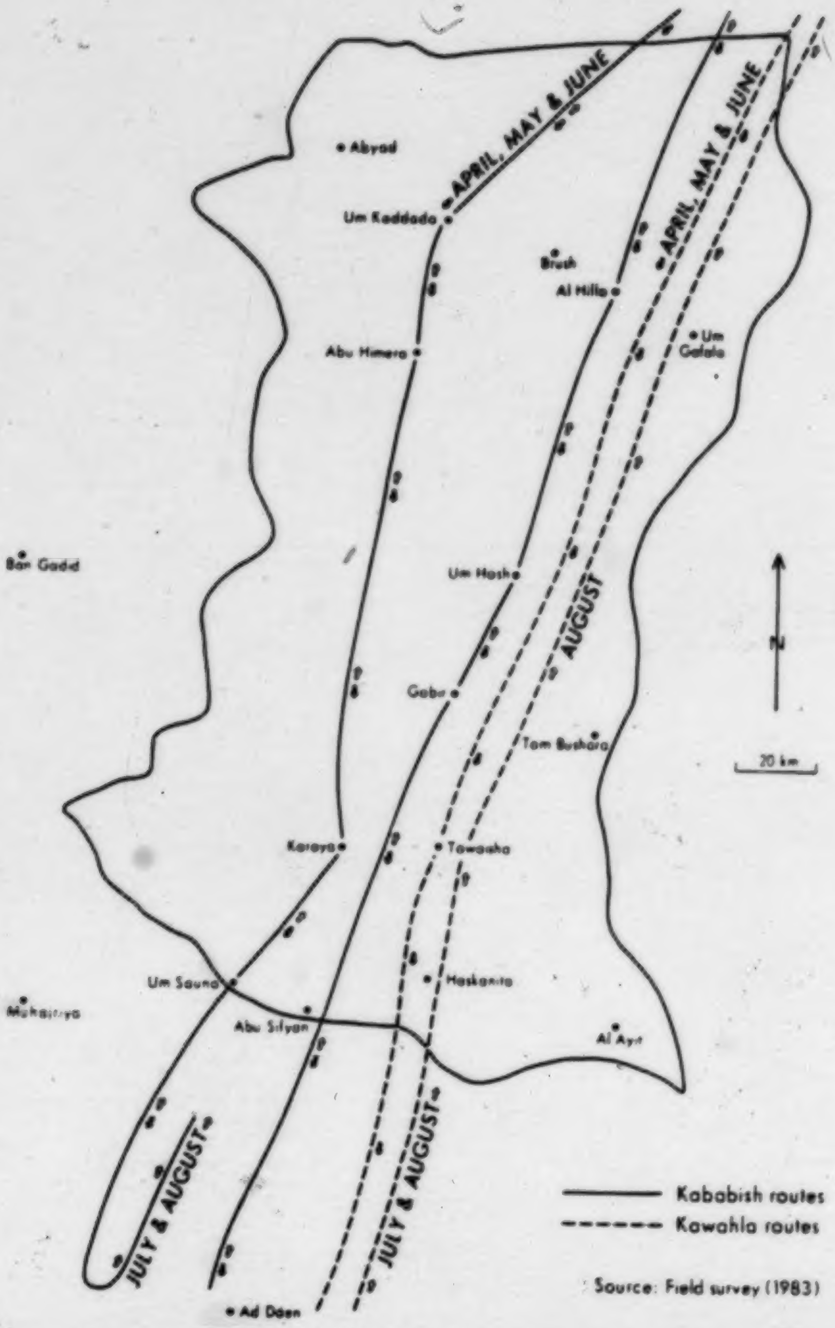
Figure 4.3 Movements of the nomads in East Kordofan

From Shirshar, some tribes advance further north to Hamarat Al Wiz (Figure 4.3), and some even go further north to Al Safya in Dar Kababish. These groups stay in Hamarat Al Wiz and Al Safya until December before they start returning southward. Another group of the pastoral nomads migrate from Shirshar to the northeastern part of E. Kordofan to an area called Al Baga (Figure 4.3). It is an uninhabited place with rich pastures, but water is not available in most parts of it, despite the fact that five boreholes have been opened there. The pastoral nomads stay at Al Baga until January, when some of them move to the western bank of the Nile, but the majority move towards the south. By February they reach the *damers* in the southern and the central part of E. Kordofan (Figure 4.3). Another group move from Shirshar southwards on their way to the *damers*. This journey might take them over two months. On their way southward, great efforts are made to prevent animals from destroying farms. The animals, however, like to graze the juicy plants on farms. After the harvesting of crops, the animals graze plant residues. From the *damers*, some tribes advance southward to the Nuba mountains (Figure 4.3), and reach them in February.

In early summer (March-April) the Kababish, the Kawakla and the Hwawir enter E. Kordofan. Some of them stay in E. Kordofan and some advance further south to the Nuba mountains (Figure 4.2). Others stay in E. Kordofan until October, and then some move northward to their grazing ground at the beginning of the rainy season (July) (Figure 4.3).

On the other hand, the Kababish, the Kawahla and the Zayadia enter E. Darfur in April, May and June on their way southward. The Kababish and the Kawakla take two definite and parallel migratory routes. The Kababish follow the western route whereas the Kawahla follow the eastern one (Figure 4.4). They choose to migrate in these parallel route for the convenience of movement and to avoid mixing their animals together. In some cases both of these two groups might follow one route.

The movement southward is called "*Nigu*," it is interesting to note that animals always start the migration southward or northward by themselves, and are followed by their owners later. The Zayadia and Tungor enter E. Darfur at the same time from the northwest. The


APRIL, MAY & JUNE
APRIL, MAY & JUNE
AUGUST
JULY & AUGUST
JULY & AUGUST
Abyad
Um Kaddada
Brush
Al Hilla
Um Gafala
Abu Himera
Ban Gadid
Um Hash
Gabr
Tom Bushara
N
20 km
Karaya
Tawasha
Um Sauna
Haskanita
Muhairiya
Abu Sifyan
Al Ayit
Ad Daen
Kababish routes
Kawahla routes

Source: Field survey (1983)

Figure 4.4 Migratory routes of the Kababish and the Kawahla across East Darfur

Zayadia extend their journey south to Um Hosh and Muhajriya and the railway, and some of the Zayadia move westward from Um Hosh to Ban Gadid (Figure 4.5). Hamar enter from the east at about the same time (April, May and June). When all of the above mentioned tribes start their journey northward or eastward at the beginning of July, the Rizeigat enter from the south and stay in E. Darfur until October. The ***damers*** for all of these tribes are found in the southwestern corner of E. Darfur. This area extends south to the railway (Ad Daen), southwest to Muhajriya, and westward to Ban Gadid (Figure 4.6). Most animals travelling from the north are pregnant, and give birth between May and July. This is the only time of the year when there is no sale of animals in large numbers.

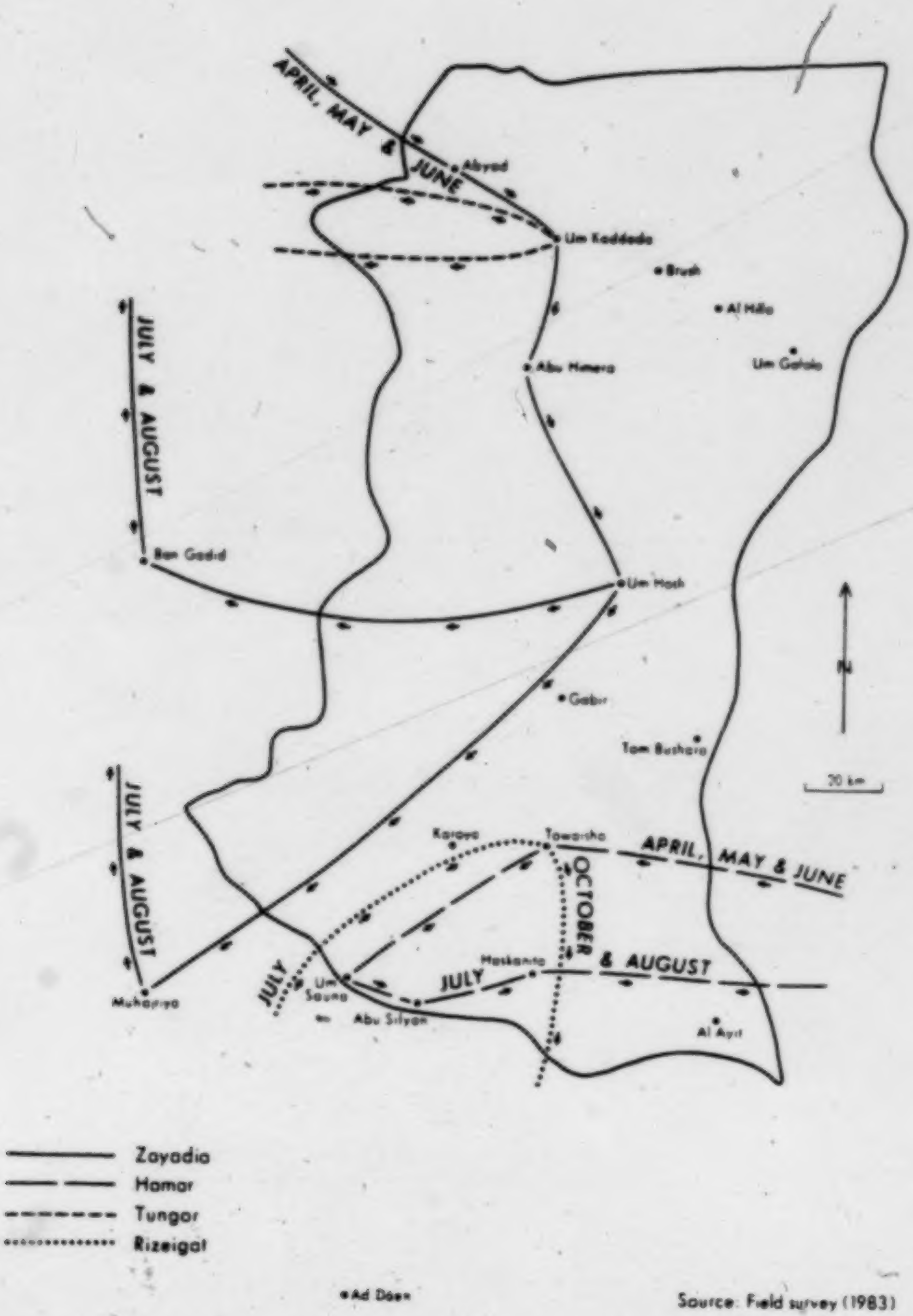
From the beginning of July until early August, the tribes of the north (the Kababish, the Kawahla, and the Zayabia) start their movement northward. The movement northward is called "***Nishog.***"

4.4.3 Cultivation by the nomads

Some of the pastoral nomads practise agriculture, especially those who live with the peasant farmers like the Shanabla in E. Kordofan, or those who are considered to be semi-nomads like Zayadia (Ibrahim 1983). Other tribes, like Hamar in W. Kordofan, are divided; that is, part of the tribe is settled, and part of the tribe practises nomadism full time. The crops cultivated include ***dukhn***, ***waka***, and sesame (Plate 4.2).

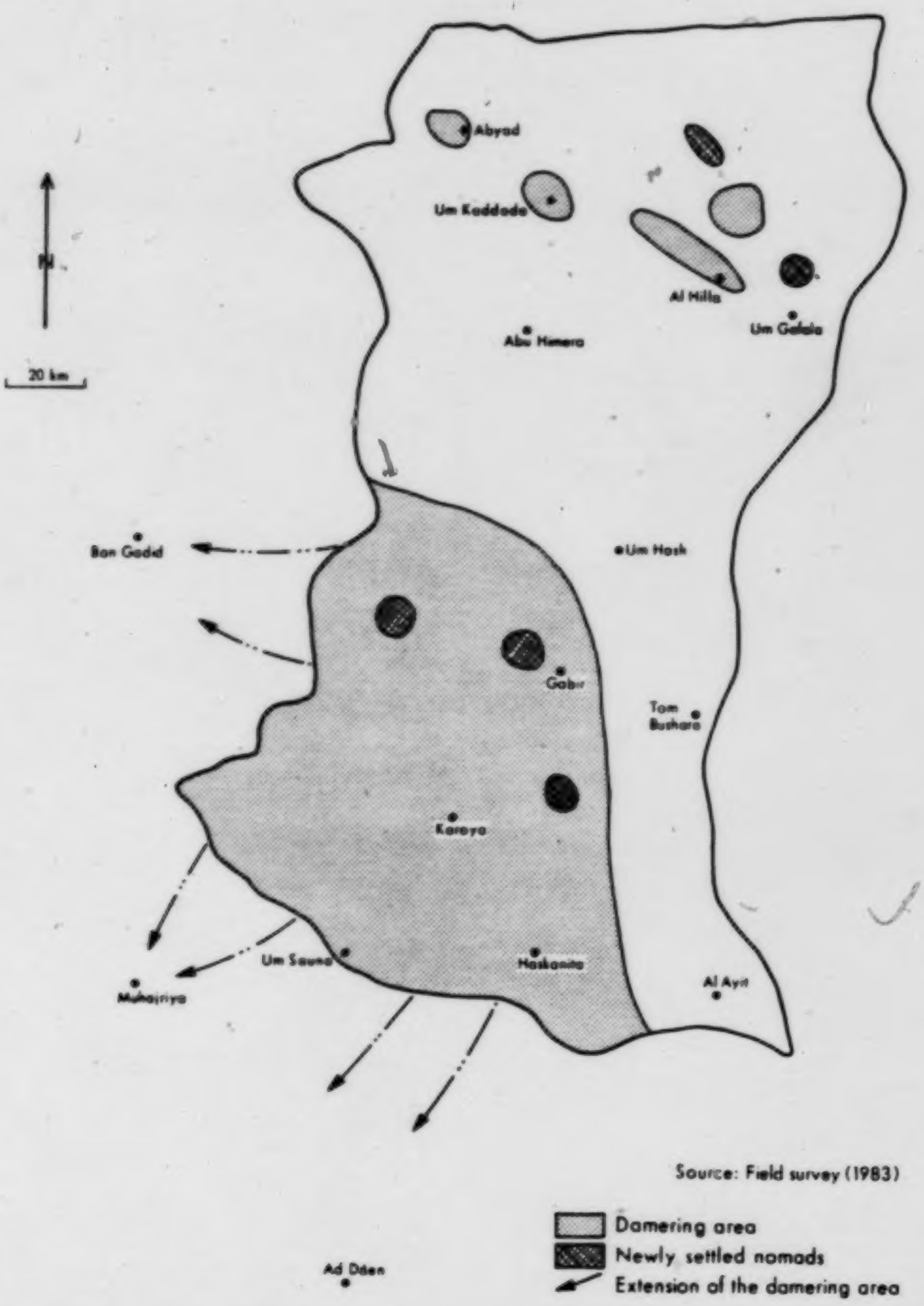
4.5 Summary

This chapter describes some of the socio-economic characteristics of the peasant farmers and the pastoral nomads. Examination of age groups for both farmers and nomads suggest that agriculture and nomadism are not attractive jobs for younger people, since less than one-fifth of the farmers and the nomads are 30 years old or less. The vast majority of the peasant farmers and the pastoral nomads are illiterate or barely literate. The pastoral nomads are the least educated of the two groups, yet dispite this fact the vast majority of them had a


APRIL, MAY & JUNE
Abyad
Um Keddada
Brush
Al Hilla
Um Gotolo
Abu Himera
JULY & AUGUST
Ban Gadid
Um Hosh
N
Gabir
Tam Bushara
20 km
JULY & AUGUST
Karaya
Tawaisha
APRIL, MAY & JUNE
OCTOBER & AUGUST
Haskanita
JULY
JULY
Um Sauna
Muhajiya
Abu Silyan
Al Ayil
Zayadia
Hamar
Tungar
Rizeigat
Ad Daen

Source: Field survey (1983)

Figure 4.5 Migratory routes of some nomadic tribes in East Darfur


N
20 km
Abyad
Um Kaddada
Al Hilla
Um Gafala
Abu Himera
Ban Gadid
Um Hash
Gabir
Tom Bushara
Karaya
Um Sauna
Haskanita
Muhajriya
Al Ayit
Ad Daen
Damering area
Newly settled nomads
Extension of the damering area

Source: Field survey (1983)

Figure 4.6 Damer places of the nomads in East Darfur

Plate 4.2 A nomad on his farm talking to the author at Abu Sifyan village in E. Darfur

positive attitude towards education.

Most of the peasant farmers had large family sizes and cultivated a relatively small-sized farm. Generally, they owned their farms, and grew food and cash crops. The peasant farmers were involved in farming activity the whole year round. Some used hired labourers, but the majority did not, depending on themselves and their family for labour. It was found that weeding and seeds, especially ***dukhn*** and sesame, were the highest costs incurred by the farmers. The peasant farmers kept some animals for milk, meat, cash, and transportation. The on-farm income is always supplemented by an off-farm income. These findings reflect the main characteristics of the traditional agriculture.

The pastoral nomads keep a variety of animals in order to withstand environmental changes and to enable the selling of animals when the need arises. Nomads migrate southward with their animals at the end of winter and early summer (Feb.-April). They remain near the water points (*damers*) during the summer, and move northward at the beginning of the rainy season (July). In recent years, the nomads have advanced further south due to the sparsity of grass. As a way of adapting to their environment, some of the pastoral nomads practise farming. They cultivate ***dukhn*** for family and animal consumption, and this has become especially important during the recent years of drought.

The current drought, however, has disturbed the harmony and equilibrium of the ecosystem in the study area. In response to this disruption, various adjustments have been implemented by the different groups in order to cope with drought. These will be considered in greater detail in Chapter 7.

Chapter 5

Drought in The Sudan

This chapter intends to show the extent of drought as a historical as well as a comtemporary problem in the Sudan. The effect of drought on agriculture for a number of years, in particular 1982, on animal resources, animal product, prices of grain, social life and natural resources such as water sources and natural vegetation is discussed. Historical and meteorological records have been examined but most of the information cited was drawn from the field survey, observation sheets, desertification literature, and newspapers and magazines.

5.1 Drought in historical perspective:

A review of the literature shows that periods of drought have occurred throughout the history of the Sudan. In most cases, these were followed by famines and outbreaks of disease. With the exception of the great famine (1888-89), they are all poorly documented.

As may be seen from Table 5.1 the earliest famine in the past few centuries occurred during the Fung era in 1684. It was called the great famine or Um Lahm (O'Fahey and Spaulding 1975). Hill (1970) stated that 1835-38 were known as the "years of famine" and that, in 1836 *cholera morbus* spread through the country striking down a population already weakened by hunger. Al Gudal (1983) states that a slight famine struck the central and the eastern part of the Sudan in 1885. Churchill (1899), Duncan (1952), Farwell (1967), Holt (1970) and Slatin Pasha (1869) all agreed that the 1889 famine be called the great famine. Slatin Pasha (1869) who was present in Omdurman during the time of the famine as the prisoner of Al Khalifa, reported that hundreds of thousands of individuals died. Failure of rains (drought) for two years (1888-89) was the main reason behind the famine. He also reported that prices rose to 40 dollars and then 60 dollars for one *Ardab* (2 sacks of grains). People were forced to sell their children as slaves, not for money, but to save their lives. When the situation improved, children were bought back, but at inflated prices. Further stories about the famine were reported by Slatin Pasha (1869).

TABLE 5.1

Years of famines and drought that are reported by historians in the Sudan

Years of Drought or famines	Name & Damage	Areal Extend	Source
1684	"The great famine" (Um Lahm)	sinnar region	O'Fahey and Spaulding (1974)
1835-38	"Years of famine"	C. Sudan	Hill (1970)
1836	Cholera morbus spread through country		Hill (1970)
1885	slight famine	C. & E. Sudan	Al Gudal (1983)
1888-89	hundreds of thousands died	C. & N. and E. & W. Sudan	Slatin Pash (1896)
1888-89	no rain for a year, crops failed & grain became increasingly scarce. Prices rose to 40 dollars & then $60, for 2 sacks of dura people sold their children as slaves to save their lives & later bought them with higher prices.	Central, northern & E. Sudan	Duncan (1952) Farwell (1967) Churchill (1899) Holt (1970)
1888-89	thousands died of hunger & disease	C, N, E, W. Sudan	MacMichael (1934)
1890	Locust & mice consumed the products	The Nile area	Farwell (1967) Duncan (1952)
1913	Poor rain, corn brought from India & issued freely in distressed areas & cheaply elsewhere	N. Sudan mainly	MacMichael (1934)
1914	"The year of the flour" (flour brought from. India because of bad rains)	C. Sudan	Henderson (1965)
1927	slight famine	C. & E. Sudan	Al Gudal (1983)

During this famine, MacMichael (1934) reported that thousands died of hunger and disease. Duncan (1952) and Farwell (1967) illustrated that in 1890 rain was abundant and the people of the Sudan were relieved. Farmers were expecting a bumper crop, but as harvesting approached, locusts and mice consumed the crop. In turn, the inhabitants consumed locust as the only source of food. It is worth mentioning that people interpreted this misfortune as a kind of punishment from ***Allah*** (God) for their bad deeds. All parts of the Sudan were affected, especially the northern and the central parts. The Khalifa, or the Sudanese ruler sent for the people of the Gezira, (the land area situated between the Blue and the White Nile) who were affected to a lesser degree, and asked them to give grain freely or otherwise have it taken by force (Farwell 1967).

In the year 1913, poor rains resulted in corn being imported from India to alleviate the problem of food shortage (MacMichael 1934). The same year witnessed the lowest recorded level of flooding of the Blue Nile this century (Al Ayam Newspaper 1984 : d; Dobri 1985), which may indicate that rainfall was insufficient to raise the level of the Nile. The following year (1914), flour was imported from India. For this reason, the year 1914 was known as the year of flour (Henderson 1965). According to Al Gudal (1983), 1927 also was a year when the Sudan experienced a slight famine.

In many of the above mentioned years, drought was significantly related to famine. In addition to this, another major factor which contributed to the great famine of 1889 was the lack of farmers. This was the result of farmers joining the army to fight in Egypt and Ethiopia. Therefore, famines are not merely products of drought, but can be the results of political factors as well.

5.1.1 Past years of drought in the study area:

Memories of severe years of drought that are mentioned by the farmers of E. Kordofan and E. Darfur extend to the beginning of this century (Table 5.2).

TABLE 5.2

Years of severe droughts in the study area "E. Kordofan and E. Darfur"

Years	Known locally as	# of villages from which years of drought were recorded No.	%	Region	Source
1912		1	2.7	E.K.	Field survey
1914	Um Mikhata, Um Korsan	2	5.5	Both	"
1917		1	2.7	E.K.	"
1918		1	2.7	E.K.	"
1927	Um Mikhata, Um Koraib	2	5.5	Both	"
1928	Um Ritail	1	2.7	E.K.	"
1929		1	2.7	E.D.	"
1930	Um Koraib, Um Fino	3	8.3	E.K.	"
1933		1	2.7	E.K.	"
1934		1	2.7	E.K.	"
1935	Um Laban "milk", Um Malwa	2	5.5	Both	"
1937		2	5.5	Both	"
1940		1	2.7	E.K.	"
1941		2	5.5	E.K.	"
1942	Um Ritail	5	13.8	Both	"
1944	Um Fino	1	2.7	E.K.	"

TABLE 5.2 continued

1945	Um Ritail	3	8.3	Both	•
1946	Um Sittasher	2	5.5	E.K.	•
1947	Um Mikhata, Um Huskanita	1	2.7	E.D.	•
1948	Um Mikhata, Um Huskanita	1	2.7	E.D.	•
1949	Sanat Al Harga	2	5.5	Both	•
1950	Um Ishreen	2	5.5	E.D.	•
1951		1	2.7	E.D.	•
1952	Um Korsan, Um Sittasher	2	5.5	E.K.	•
1956		1	2.7	E.D.	•
1957	Sanat Al Harga	1	2.7	E.K.	•
1959		1	2.7	E.D.	•
1960		2	5.5	E.D.	•
1961		1	2.7	E.K.	•
1963		1	2.7	E.K.	•
1964		1	2.7	E.K.	•
1966		2	5.5	Both	•
1968	Um Korsan	2	55	E.K.	•
1972	Um Koraib	1	2.7	E.K.	•
1973		4	11.0	E.D.	•
1974		2	5.5	E.D.	•

Elderly people in group interviews were asked to point out years of severe droughts and famine. As may be seen from Table 5.2, drought was first mentioned locally in 1912. It can also be observed that 17 out of 36 drought years were given names. The meaning of these names reflects the magnitude of drought, as well as the hardship that was experienced by people.

An examination of these names reveals that some of them were named after certain types of plants. These plants were eaten by animals, but during times of scarcity and extreme hardship, people also were forced to eat them as the only means of survival. The years 1914, 1924, 1947, 1948, 1952 and 1968 were given the names ***Um Mikhata*** or ***Um Korsan*** which is known as (***Boscia senegalensis***). It is a bitter tasting bush. Its fruit must be kept in water for two months before it can be eaten by human beings and the water should be changed every 5-7 days; the plant has little nutritional value. ***Haskanit*** (Cenchrus ciliaris) and ***Koraib*** (Brachiaria) both are good, tasty plants for animals, but are only eaten by human beings in times of severe food shortage. However, self-pride, as well as the availability of and accessibility to grain, prevent people from eating these plants. During times of scarcity, however, they have no choice. When the droughts are over and the problems are forgotten, the names of these plants remain, having been engraved in the memories of the local people as reminder of the years of bitter hardship. In addition to 1927, 1947 and 1948, 1930 and 1972 also were named after these plants.

Um Fino (wheat flour), a name mentioned for two years, 1930 and 1944, refers to the scarcity or lack of grain during these years, so much so that flour (which was something unusual) was imported into the country.

Some other years were named after very small weight and capacity measurements, like ***Um Rital*** (the diminutive form of lb.) and ***Um Malwa*** (1/30 of a sack). It is interesting to note that people used to buy grain with sacks, but during severe years of drought or grain scarcity, it was only possible for them to buy grain with the smallest measurements like one pound or ***Malwa*** (approximately twice as much as two hands full of grain). Therefore, 1928, 1942 and 1945 were marked by ***Um Rital*** (one lb), whereas, 1935 was given the name ***Um Malwa***.

Although both *Um Rital* and *Um Malwa* years were sharing the same characteristics, the year 1935 might be considered as not as severe as *Um Rital* years, because the unit of measurement is bigger.

In times of scarcity, prices were expected to rise. In some years they increased sixteenfold, and in others even more so. The people of the study areas named some of the years after these high recorded prices. In E. Kordofan, prices increased sixteenfold, in 1946 and 1950, so these years were called *Um Sittasher* (sittasher = 16). Similarly, in E. Darfur, prices had set a record in 1952. They increased twentyfold, so accordingly that year was called *Um Ishreen* (Ishreen = 20).

Besides *Um Malwa*, the year 1935 was given another name in E. Kordofan. It was called *Um Laban* (Laban = milk), because people did not find enough water to drink and they drank milk instead. Animals were able to produce milk because they ate water melon in the absence of both water and grass. This year differs from the above mentioned years in that the lack or scarcity of water was the key factor, whereas in the other years, crop failure or scarcity of grains was the problem. Crop failure in 1949 and 1957 was complete and devastating. In Shurri and Abu Saad in E. Kordofan each of these years were called *Sanat Al Hurga*, or "the year of burned crops."

It should be noticed that of the seven years (1927-35) which were mentioned as drought years, four of them were given names, showing the severity of drought. Moreover, with the exception of the year 1943, twelve consecutive years (1940-52) were identified by the inhabitants as drought years. Eight consecutive years (1942-50) were identified as being severe years of drought, and given names. In three of these eight years, drought occurred in both regions (1942, 1945 and 1949). Of all the decades of this century, the forties were recognized to be the hardest of all for both regions.

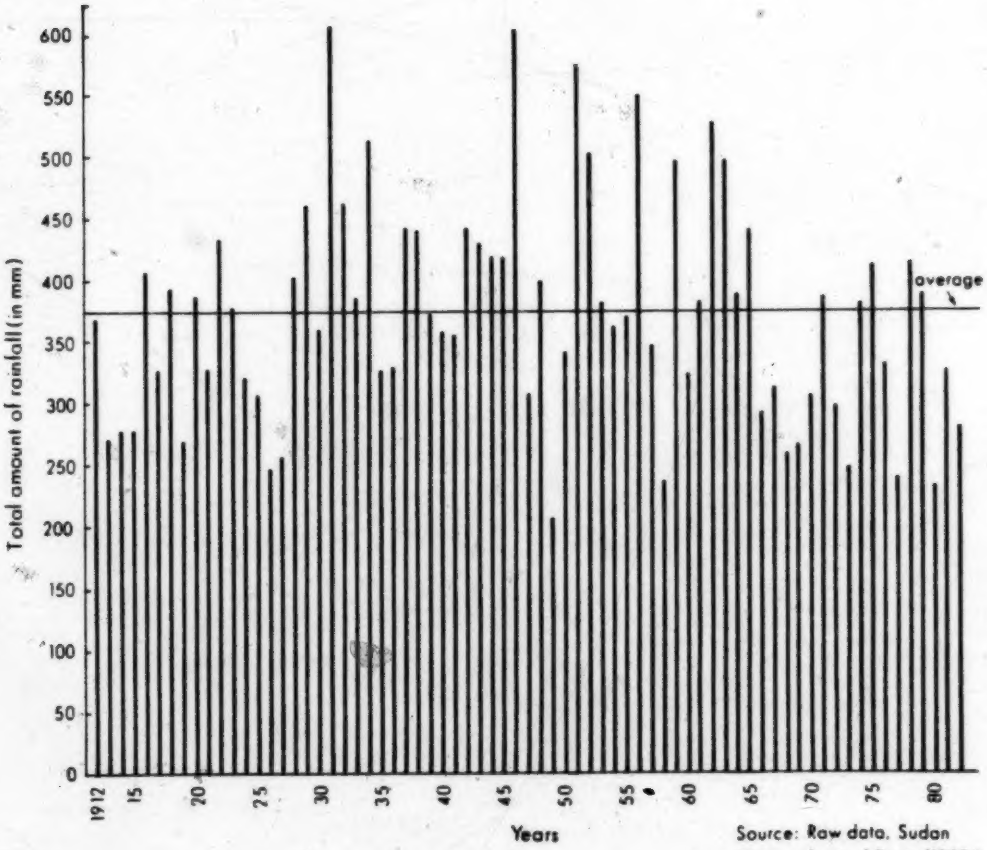
5.1.2 Comparison between perceived years of drought and the meteorological records

Records of rainfall distribution in both Um Rowaba and Al Fasher towns (Figure 2.9) extend back to 1912 and 1917 (Figures 5.1 and 5.2). These years have been used here for comparison, since they are the only records in both regions that go back that far. Although these records might not reflect the true situation, they are close enough to give an idea of the amount of rainfall in the different years. Um Kaddada in E. Darfur would be more appropriate than Al Fasher, but rainfall records in Um Kaddada only began as late as 1945.

Table 5.2 illustrates that eight years of severe drought are shared by both regions, these years being 1914, 1927, 1935, 1937, 1942, 1945, 1949 and 1966. Six of these eight years were identified by local names. Because the year 1942 was mentioned in five different localities (villages) it must have been a very dry year. It also indicates that the areal extent of drought was vast. Another indication of the severity of the 1942 drought was that three villages (Towaisha, Haskanita and Um Sauna) are located in the southern part of E. Darfur, where rains are generally adequate.

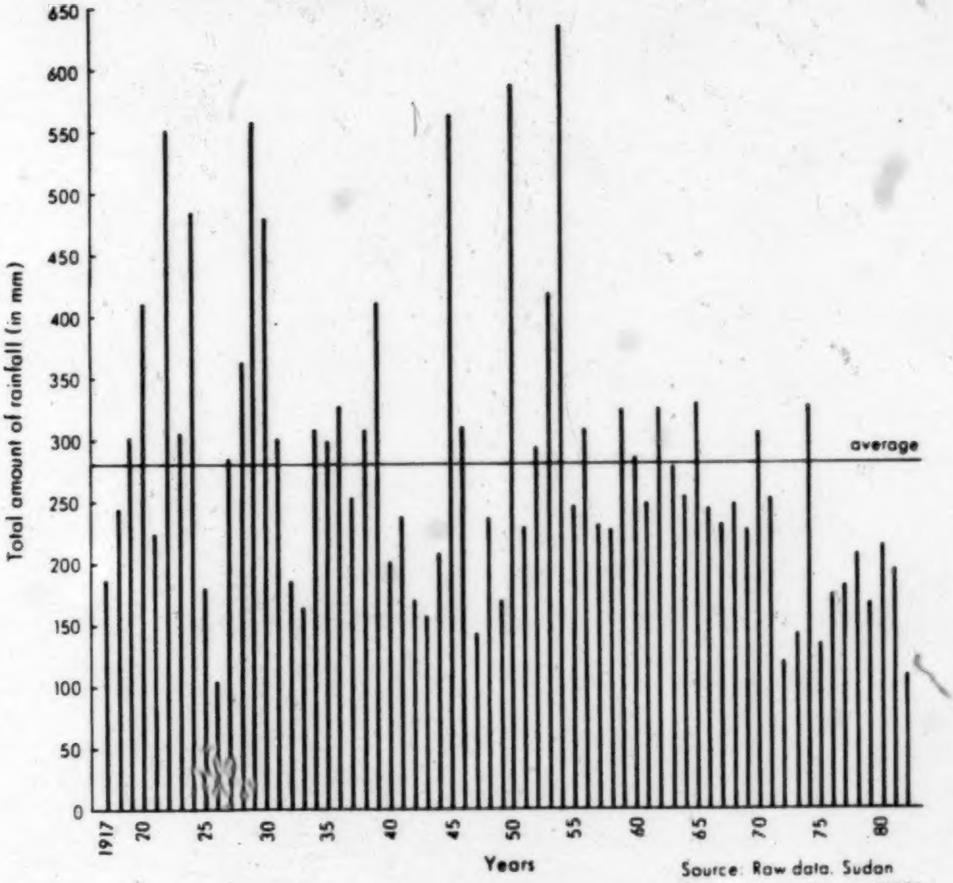
An examination of Um Rowaba record (Figure 5.1) confirmed that five of the above eight years (1914, 1927, 1935, 1949 and 1966) had low rainfall. The criteria used to determine degree of rainfall are based on whether rainfall is above or below average, and in the above mentioned years, rains were well below average. Similarly, five of these eight years received rains well below average at Al Fasher station (Figure 5.2). These years were 1914, 1937, 1942, 1949 and 1966. This result indicates that 1914, 1949 and 1966 were the driest of the eight years mentioned above. Although there was no record of rainfall in Al Fasher in 1914, it was still included in these eight years, because it was given a special name in both regions, and this indicates a year of exceptional hardship.

Surprisingly, Figures 5.1 and 5.2, reveal that the year 1926 was recorded as having one of the lowest amount of rainfall, yet it was not mentioned by the people of either region as a drought year. However, it had its effect in the following year (1927), which was mentioned in both regions as a drought year. Another noticeable feature is that 1945 was mentioned as a



Source: Raw data. Sudan Meteorological Dept. (1983)

Figure 5.1 Total amount of rainfall in Um Rowaba for the period 1912-1982 (in mm)



Source: Raw data. Sudan Meteorological Dept. (1983)

Figure 5.2 Total amount of rainfall in Al Fasher for the period 1917-1982 (in mm)

drought year, but examination of Figure 5.2 (Al Fasher) shows that it was not recorded as such. In fact, rainfall in that year was exceptionally high (560mm), 282mm above average. It also was found to be above average at Um Rowaba (Figure 5.1). Probably there was some other reason(s) which led to the shortage of grain, or possibly the memories of the people were not accurate.

5.2 Years of severe droughts in each region:

On a regional level, in E. Kordofan and according to Um Rowaba record (Figure 5.1), it was found that 13 of the 26 perceived years of drought (table 5.2) recorded rainfall below average. Those years were, 1912, 1914, 1917, 1927, 1930, 1935, 1940, 1941, 1949, 1957, 1966, 1968, and 1972. Among those 13 years, eight were given names (1914, 1927, 1930, 1935, 1949, 1957, 1968, and 1972). The year 1930 was mentioned in three different places in E. Kordofan, indicating it was a dry year for most parts of the region.

On the other hand, other perceived years of drought which have not been proved meteorologically were; 1918, 1928, 1933, 1934, 1937, 1944, 1942, 1945, 1946, 1952, 1961, 1963, and 1964. This may be due to the nature of rainfall in the semi-arid areas, where rain is a highly localized phenomenon (Hammer 1972; Hulme 1984). Again, recall of the events by local inhabitants may be faulty.

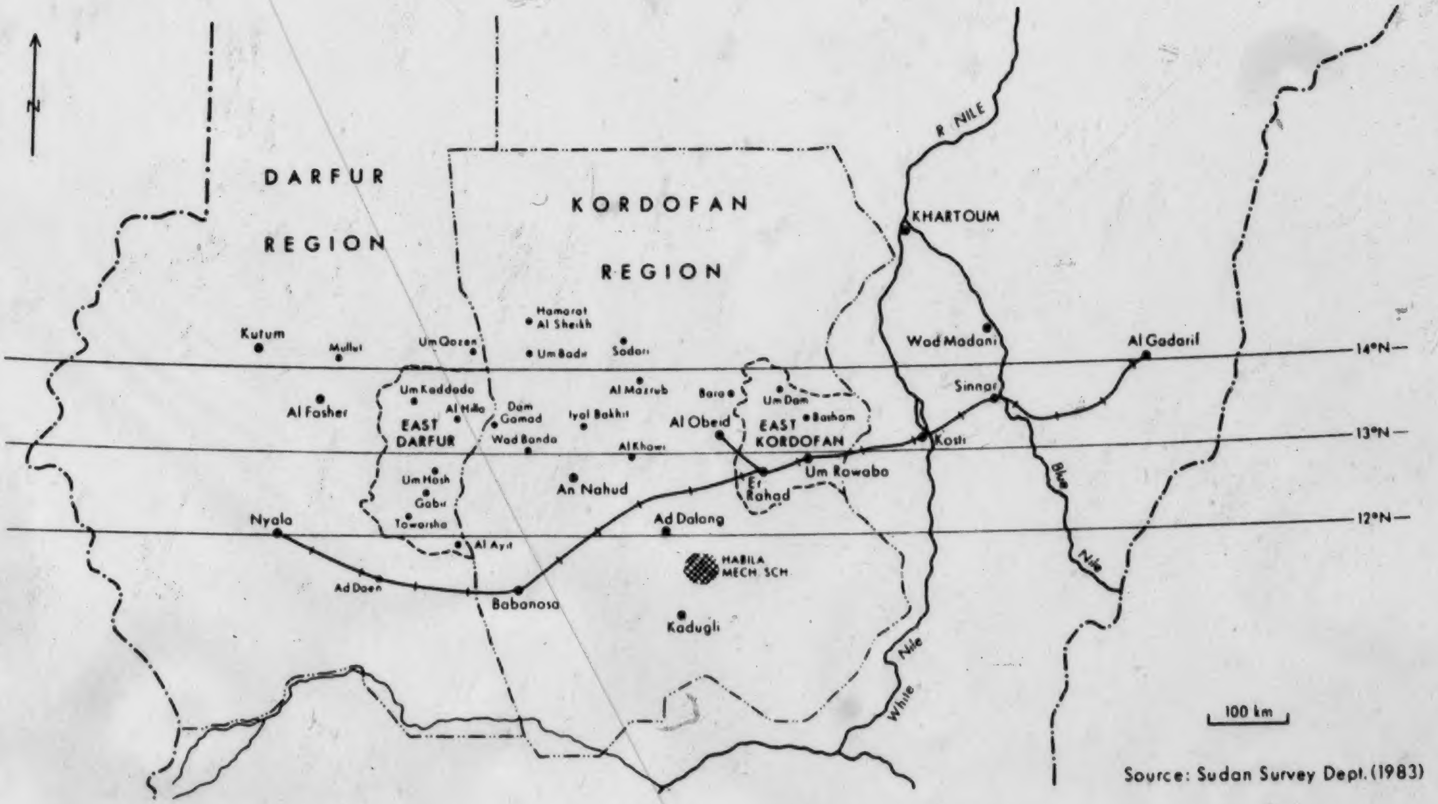
In E. Darfur (Figure 5.2) it was found that eight of the 18 perceived years of drought (Table 5.2) were proved meteorologically as being below average. Those years were, 1937, 1942, 1947, 1948, 1949, 1951, 1966, and 1973. The years 1973 and 1974 are included in Table 5.2 for the sake of comparison, since 1973 was recognized as the worst year of the Sahelian drought (1968-73). In four villages, 1973 was mentioned as a dry year, coming second to 1942. Both Al Fasher and Um Kaddada records (Figures 5.2 and 2.8) failed to recognize the years 1929, 1945, 1950 and 1959 as drought years. But contrary to how they were perceived, 1929 and 1950 had a good deal of rain. Similarly, in E. Kordofan, the year 1929 had a high amount of rain (458 mm), which was 86 mm higher than the average (372 mm), see Figure 5.1. The same is true for the years 1945 and 1959, which had rainfall as high as 418 and 495 mm, which were respectively 46 and 123 mm higher than the average (372). Figure 5.1 reports these findings.

The foregoing illustrates that failure of rains has nothing to do with the years 1929, 1945, 1950 and 1959. Most likely there were some other reasons, which have not been mentioned in the literature. It is probable that due to insects, locusts, rodents, plant disease, or for social, administrative or political reasons, the local people were subjected to some kind of grain scarcity. The localization of rainfall in the semi-arid areas may be another feature of these drought years. In another case, in many parts of Nigeria, 1945 was pointed out as a year of drought (Oguntoyinbo and Richards 1978), which may have influenced people's perceptions about their own area. Finally, it could be that people at those particular times perceived drought as a lack of food rather than rainfall.

5.2.1 Comparison between drought years at the national level and in the study area

The comparison will be made at two levels. First, a comparison will be conducted of the years reported by historians (Table 5.1) on the one hand, and those perceived by the people of the study area on the other (Table 5.1). Second, a comparison will be made between the years in Table 5.1, and the available meteorological records. Due to the limitation of the meteorological data, the comparison is only possible during this century. In fact, only three years may be included in this comparison; 1913, 1914 and 1927.

The meteorological records (Figure 5.1) concur with the historical records that identified 1913 as a drought year. With regard to both 1914 and 1927, all three factors - the perception of the people in both regions, meteorological (Figure 5.1) records, and historical records - illustrate that those two were drought years. Furthermore, 1914 was mentioned among "the named years." Therefore, it could be said that drought in 1914 and 1927 affected most of the central parts of the Sudan, from the eastern border westward to Kordofan and Darfur regions (Figure 5.3).


N
DARFUR
REGION
KORDOFAN
REGION
R NILE
KHARTOUM
Wad Madani
Al Gadaril
Sinnar
Kosti
Blue
Nile
White
Nile
Hamarat
Al Sheikh
Kutum
Mullet
Um Qozen
Um Badr
Sodari
Al Mazrub
Bara
Um Dam
Bashom
Um Kaddada
Al Hilla
Dam
Gamad
Iyal Bakhit
Al Obeid
EAST
KORDOFAN
Al Fasher
EAST
DARFUR
Wad Banda
Al Khowi
Um Rowaba
Um Hosh
Gabir
An Nahud
Er
Rahad
Nyala
Towarsha
Al Ayit
Ad Dalang
HABILA
MECH. SCH
Ad Daen
Babanosa
Kadugli
14°N
13°N
12°N
100 km

Source: Sudan Survey Dept. (1983)

Figure 5.3 The central parts of the Sudan

5.2.2 Drought in the Sudan and the Sahelian zone:

The Sudan is considered a part of the Sahelian zone. Therefore, it would be useful to see which of the years have had adverse effects in the Sahelian zone and the Sudan at the same time.

Apeldoorn (1981) states that in Nigeria, the most documented years of drought and famine were 1913, 1927, 1951-52, and 1957. He further states that 1951-52 was known as *cassava meal*. In the Sudan, all four years were pointed out as drought years. They have been varified meteorologically as represented by Figures 5.1 and 5.2. Watts and Shenton (1978) mentioned that in 1918, 1920 and 1921, harvests were very poor in northern Nigeria. The peasant farmers of E. Kordofan pointed out 1918 was a dry year, and Figure 5.2 confirms this according to meteorological records. Although 1921 was not perceived by the peasant farmers of the Sudan as a dry year, the meteorological record (Figure 5.2) showed that rainfall in that particular year was well below average (85mm) or less.

From the above findings, it could be concluded that 1913, 1918, 1921, 1927, 1951-52 and 1957 were years of drought across most of the Sahelian belt, from the Ethiopian border across the Sudan to Nigeria, and perhaps westward to the Senegal.

5.2.3 Summary

Many years were remembered by peasant farmers as years of severe drought or famine in the study area. In some years drought and famine were experienced in both regions, while in other years only one region was affected. Some years were given unfamiliar names to mark the severity of drought. For example, the names of plants such as *Um Mikhata, Um Korsan, Um Koraib, Um Haskanita* and *Um Fino* (wheat) signified the shortage of grain in those years. Some were given names of measures, such as *Um Ritail* and *Um Malwa*, which signified the amount of grain available. Others were named after numbers such as *Um Sittasher* (16) and *Um Ishreen* (20) which indicated the rise of grain prices during those periods. Others were named *Sanat Al Harga* (the burned year), and *Um Laban* (the year of drinking milk). Those years were 1914, 1927, 1928, 1930, 1935, 1942, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1952, 1957, 1968, and 1972.

Drought affected more than one region. It covered both E. Kordofan and E. Darfur and perhaps other regions, indicating severe drought conditions. The years affected were 1914, 1927, 1935, 1937, 1942, 1945, 1949, and 1966. More importantly, six of those eight years (1914, 1927, 1935, 1942, 1945 and 1949) were given names, which identifies them as the most severe years of drought. Not only are they named, but records also reveal that drought covered at least two regions. The remaining years of drought are believed to have been less severe, since they were not given names, and drought did not extend to both regions. Therefore, with the exception of 1973, the years of less severe drought are considered less important to this study. In summary, the years of severe drought in the Sudan and across most of the Sahelian belt were 1913, 1914, 1918, 1927, 1935, 1937, 1942, 1945, 1951, and 1957 (Table 5.3).

5.3 The effect of drought

This section discusses the effect of drought on crops, grain prices, animals and animal production, milk and dairy products, migration, and natural resources such as land, water, and vegetation.

5.3.1 The effect of drought on crop yields

The adverse effect of the current drought has recently been characterized by crop failure, which reached disaster proportions in 1984 to the extent that a famine and mass out-migration occurred in all semi-arid areas of the Sudan (Dobri 1985; Hulme 1984; Kaplan 1984; Miller 1985).

Dukhn (millet) and *zenari* (sorghum) are the main staple food grains, together with *waka* (okra) and *lobia*. Groundnuts, water melon, sesame, *kardadi* and gum arabic are the main cash crops, not only in the study area, but in all of western Sudan (Kordofan and Darfur regions).

TABLE 5.3

Drought years in the study area, other parts of the Sudan and the Sahel in this century

Perceived and meteorologically confirmed Years of drought in study area		Other parts of the Sudan	Drought years in the Sahel	Years of severe Drought in the Sudan and the Sahel
E. Kordofan	E. Darfur			
1912		1913	1913 (Apeldoorn 1981)	1913 (MacMichael 1934)
1914		1914		1914 (Field survey 1983 & Henderson 1965
1917			1918 (Watts & Shenton 1978)	1918 (Watts & Shenton 1978)
1927		1927	1927 (Apeldoorn 1981)	1927 (Field Survey 1983 and Al Oudal 1983))
1930				1935 (Field Survey 1983))
1935	1937			1937 (Field Survey 1983))
	1942			
1940	1947			
	1948			
1941				1942 (Field survey 1983))
1949	1949			1945 (Field survey 1983))
	1951		1951/52 (Apeldoorn 1981)	1951 (Apeldoorn 1981 and Field Survey 1983))
1957			1957 (Apeldoorn 1981)	1957 (Apeldoorn 1981 and Field Survey 1983))
1966	1966			
1968				
1972	1973			

The data presented in Figure 5.4 indicate that almost half of the peasant farmers in the study area were subjected to a complete crop failure (less than one sack[1]) in 1982. This is with reference to *dukhn*. Since *dukhn* is their main staple food, this created a serious grain shortage.

On a regional basis, comparison between E. Kordofan and E. Darfur revealed that there was a significant difference between the two regions. It was found that 47.7% of the peasant farmers were subjected to a complete crop failure of *dukhn* in E. Kordofan, whereas, in E. Darfur 42.1% lost their crops. For *zenari*, they were twice as many peasant farmers in E. Kordofan (28.2%) as those in E. Darfur (14.1%). Peasant farmers who were subjected to complete crop failure of sesame were as twice as many in E. Darfur (53.4%) as those in E. Kordofan (25.2%). A significant difference is found between the cultivators of *waka* and watermelon in both regions. The data suggest that E. Kordofan was hit harder by drought than E. Darfur, in terms of staple food (*dukhn* and *zenari*) and not the cash crop (seasame).

Figure 5.5 represents the intraregional comparison in E. Darfur between Um Kaddada R.C. (dry northern part) and Al Ayit R.C. (more humid southern part). This comparison illustrates the effect of drought on crops in two different environments, within the same region. Differences were observed between the two parts of the region. The data in Figure 5.5 indicate that there is a significant difference in terms of crop yield between the northern and the southern part of E. Darfur. It also shows that the effect of drought was more serious in Um Kaddada R.C. than in Al Ayit R.C.. Figure 5.5 demonstrates that drought has seriously affected both crop yields in the semi-arid area, as well as yields in the savanna zone to the south. Crop yields were more severely affected in the northern semi-arid area.

Comments of the peasant farmers in Um Kaddada R.C., in E. Darfur reflect the situation and their feelings:

> "You ask me about my crop yield. Ah . . . and I didn't even weed my farm"
>
> ". . . I didn't go back to see my farm after the first two weeks."

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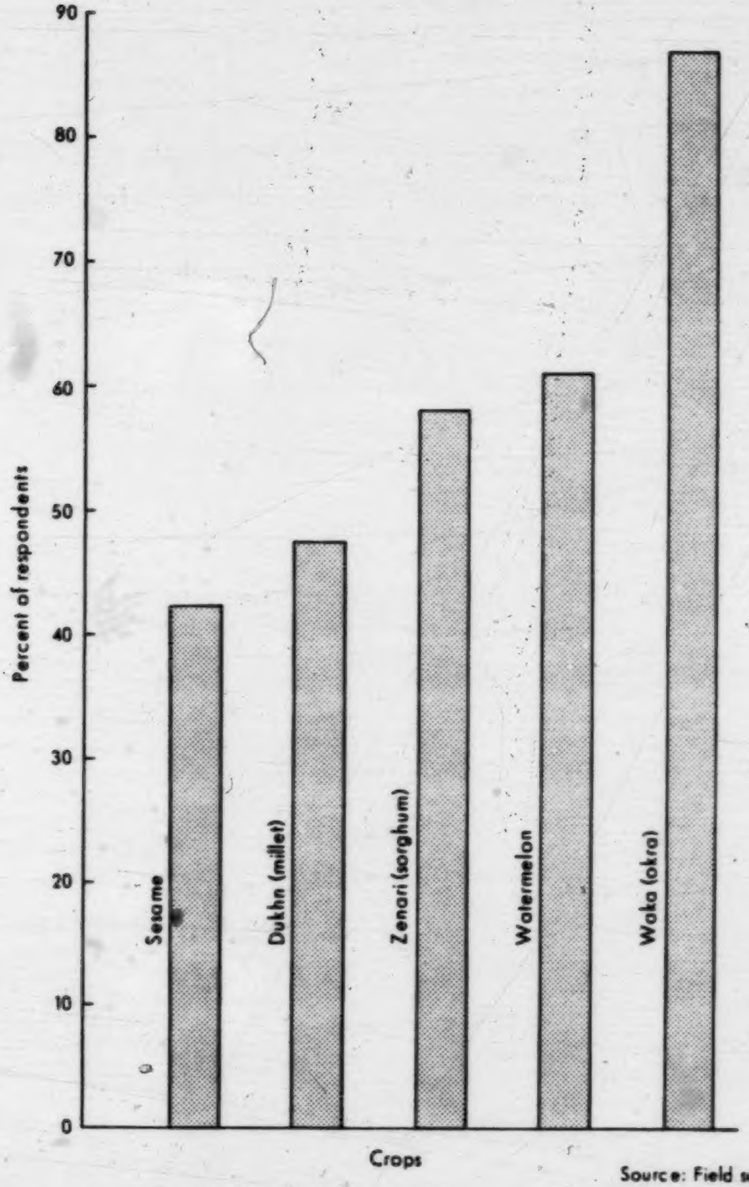
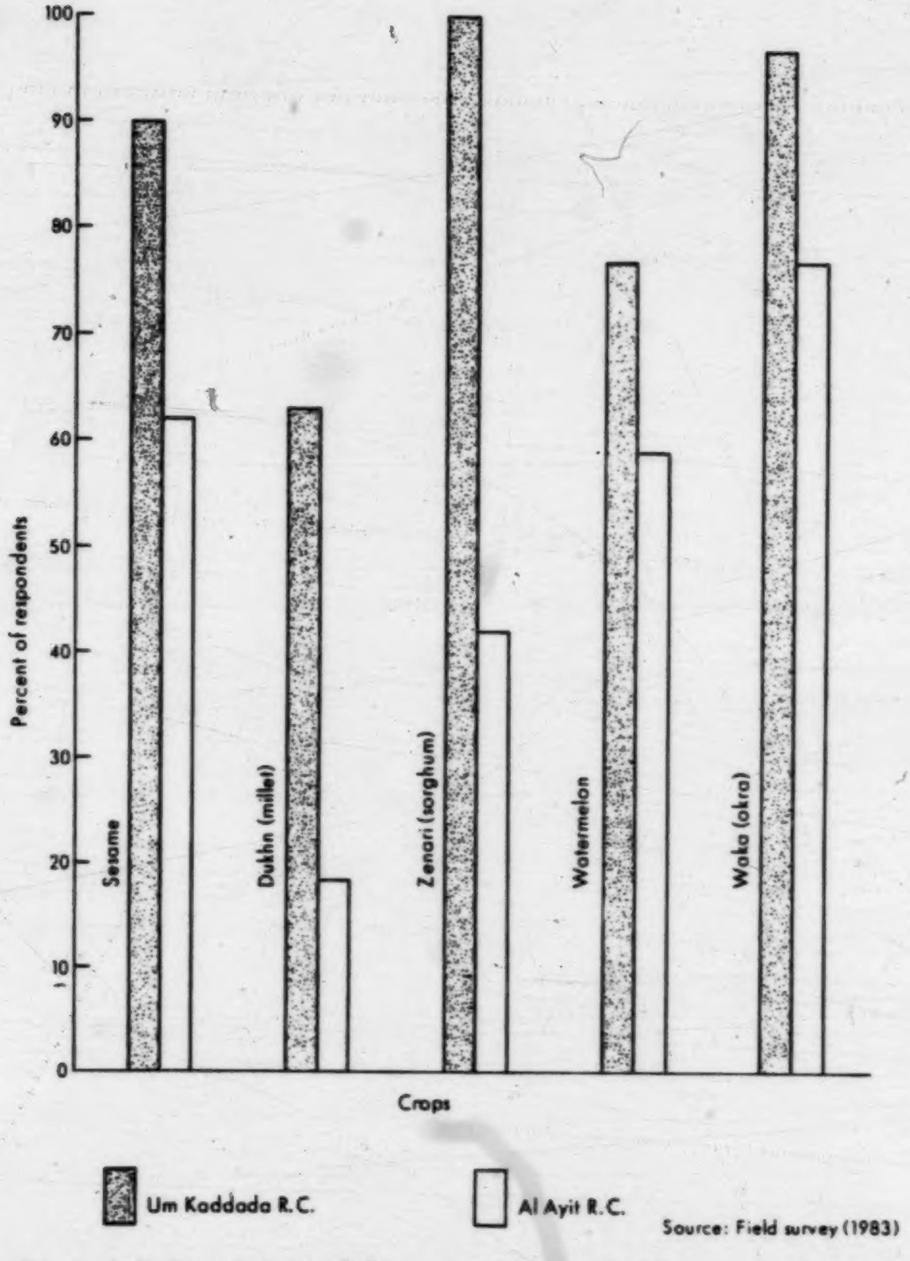
[1] A measure of capacity for agricultural production equalling 99 litres. This may weigh between 132 and 180 lb.



Source: Field survey (1983)

Figure 5.4 Percentages of the peasant farmers who were subjected to a complete crop failure (<1 sack) in 1982



Source: Field survey (1983)

Figure 5.5 Percentage of the peasant farmers who were subjected to a complete crop failure (<1 sack) in Um Kaddada and Al Ayit R.Cs. in 1982

> ". . . I haven't even got back my seeds."
> and
>
> "Four years . . . we sell animals and we eat from the market (buy grains from the market.)"
>
> "Five years and no one in this *Dar* (area) opened a *matmora* (underground grain store)"

On the other hand, percentages of those who were subjected to a semi-complete crop failure (less than 3 sacks per individual crop) were also very high. This has been shown in Figure 5.6. In conclusion, the data suggest that crop yields in the semi-arid areas were seriously affected by drought. Comparisons of crop failure in Um Kaddada R.C. (semi-arid) and Al Ayit R.C. (savanna zone) revealed that the savanna zone is equally affected by drought. Comments by the peasant farmers give the data more depth.

> "Thank *Allah* (God) I have got back my seeds"
>
> "In all of this region no one was satisfied with his crop yield for the last few years . . . our animals have all finished. We are waiting for this season to see whether we stay here or move finally out of this place."

Analysis of crop yield on a regional basis shows that there was a continuous drop in crop production (measured in gontar[2]). The data that presented in Figure (5.7) were taken from Um Rowaba crop market (Um Rowaba is the H.Q of E. Kordofan). Although these figures might not show the actual production, at least it shows the trend. It is worth noting that, it has only been possible to make comparison between these three crops since they were taxable as cash crops and records were kept in the crop markets. Other crops like ***dukhn*** and sorghum were not taxable as they are the staple food crops. They only become taxable when they are sold commercially.

As may be seen from Figure (5.7) that sesame production started to decline in 1974 and it reached the lowest point in 1982. This decline throughout that period was 87.2%. Groundnut production showed a decline between 1967 and 1969, but since then it has shown a continuous

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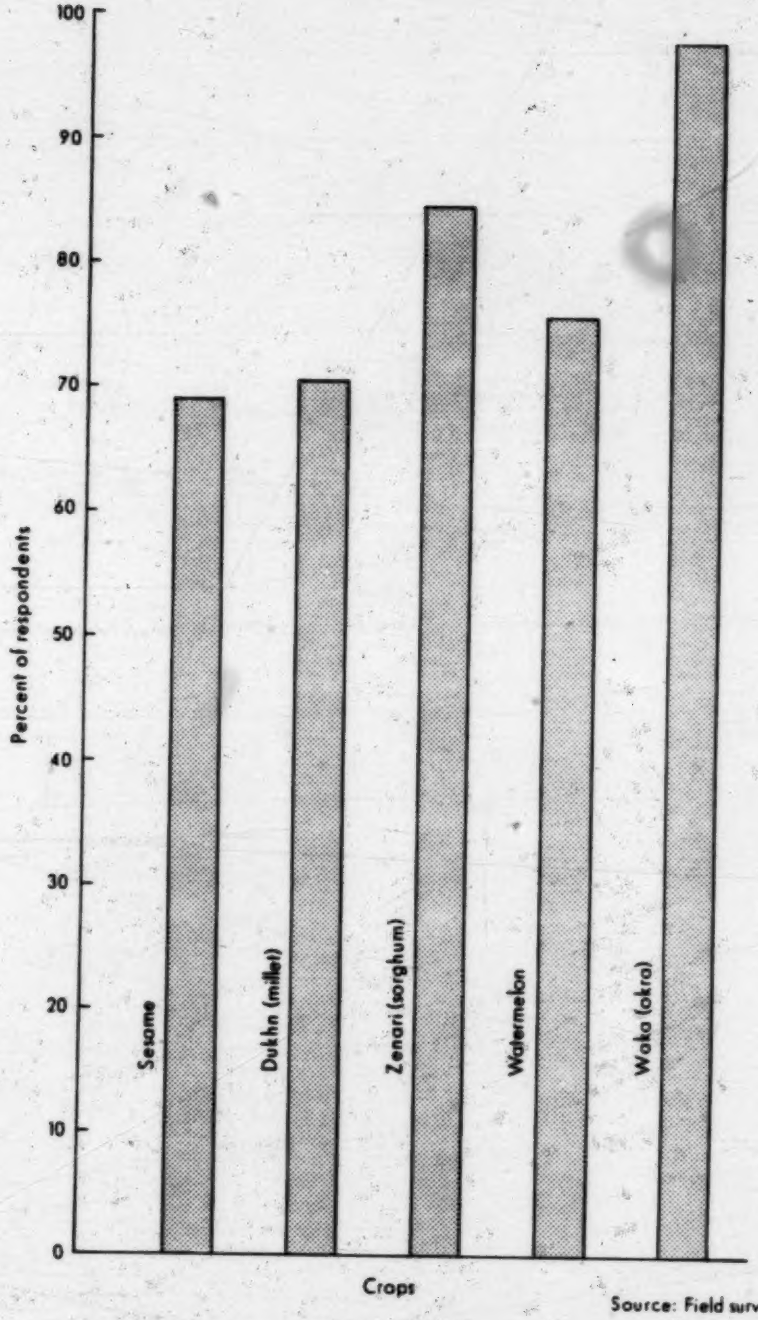
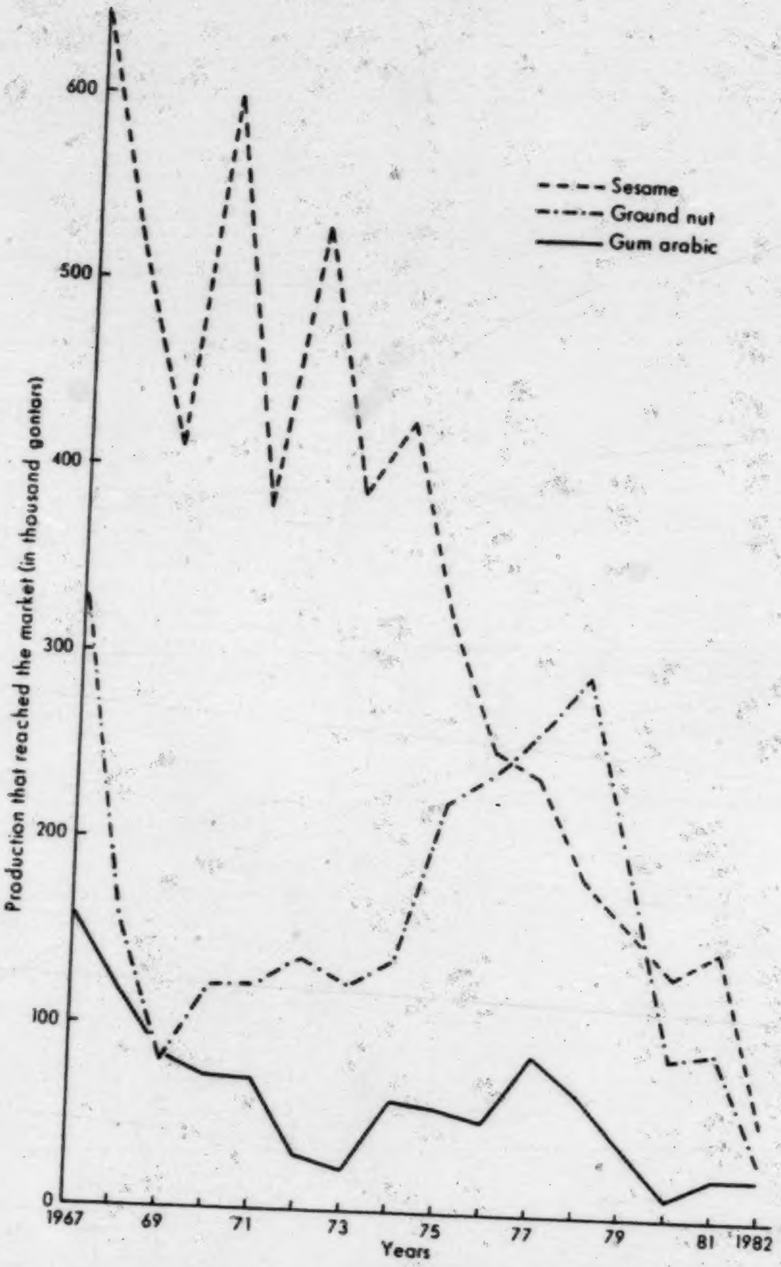
[2] Gontar = A measure of weight which equals 100 lb.



Source: Field survey (1983)

Figure 5.6 Percentages of the peasant farmers who were subjected to semi-complete crop failure (< 3 sacks) in 1982



Source: Raw data, Um Rowaba Crop Market (1983)

Figure 5.7 Crops that sold at Um Rowaba crop market (in gontars) for the period 1967-82

improvement until 1978, when it started to drop again steadily to 1982. Production of gum arabic tended to decline between 1973 and 1976. It showed slight improvement between 1974 and 1977. This period was followed by another period of declining productivity, reaching its lowest point in 1980.

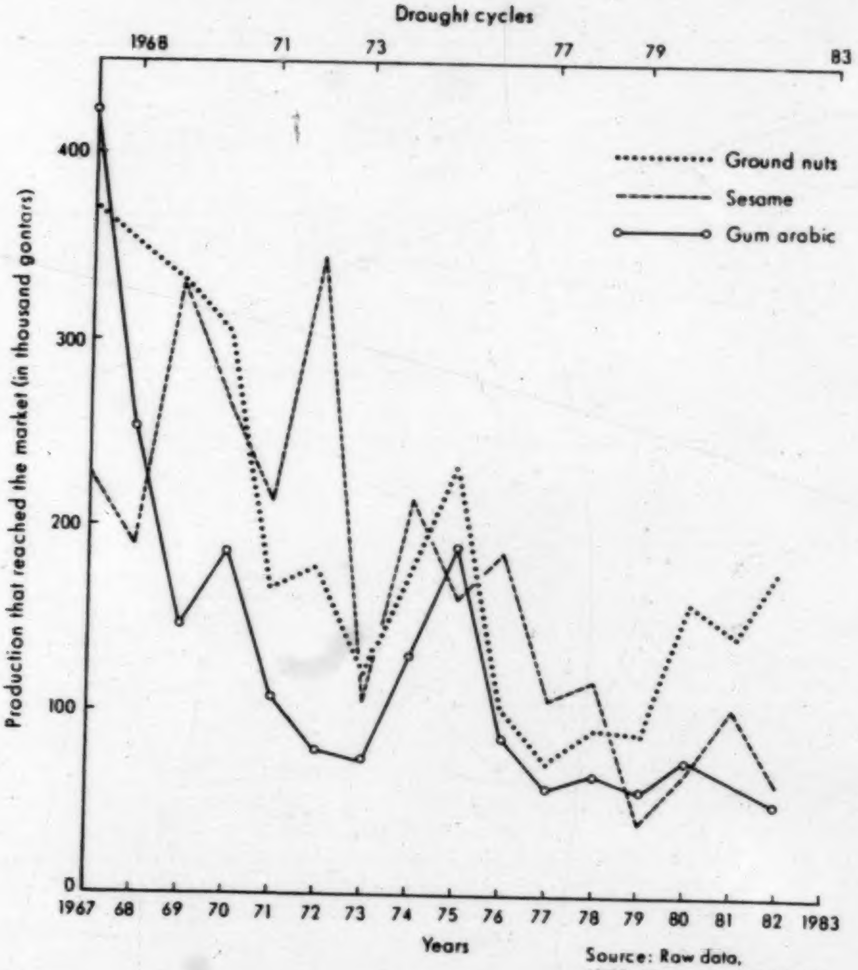
It was observed that there were some years in which there was a clear drop in the production of the three crops at the same time, for example 1968, 1969 and 1973 (the beginning and ending of the Sahelian drought 1968-73). Moreover, 1980 showed the same trend. On the other hand, 1981 showed a slight improvement in the production of all three crops.

Drought in the last five years (1978-82) has had a serious effect on the economy of the peasant farmers of E. Kordofan. Hulme (1984) reached the same conclusion. Similarly, Trilsbach and Hulme (1984) have related the decline in yield and productivity since mid/late 1960s at least in part to poorer rainfall. As previously mentioned, 1982 recorded the least crop production. Farmers from the region who commented on this year(1982) were often perturbed by the low yield:

> "We haven't seen a bad year like this, and even our fathers haven't told us about a year like this."

Figure 5.8 illustrates that analysis of crop records at Al Obeid crop market showed that productivity declined during the last 16 years (1967-82). The decline of productivity might be related to various commercial factors such as supply and demand, prices, availability of labour in peak season, marketing system, transportation accessibility, and natural problems like wind, insects, disease, floods, and drought. It is very difficult to isolate one reason as being responsible for the decline of productivity. On the other hand, interviews with the peasant farmers revealed that drought was a key factor behind the decline of productivity.

It should be noted that while there is a possibility of sesame and groundnuts escaping the crop market through smuggling directly from farm to oil factories, gum arabic would not have that chance. Because gum arabic is processed outside the country, only a very minor proportion is kept for local light industries. Therefore, the peasant farmers or crop merchants



Source: Raw data,
Al Obeid Crop Market (1983)

Figure 5.8 Crops that sold at Al Obeid crop market (in gontars) for the period 1967-82

have to bring it to the crop market. Consequently, the effect of drought is more visible in the quantity of gum arabic in the markets than that of sesame and groundnuts.

Writers like Ebaidalla(1978) attributed the decline of gum arabic productivity to marketing policies and prices, but neglected other factors. Abd Al Gaffar(1982 : a) has listed many of the problems relating to the gum arabic belt in general (semi-arid areas), and placed drought on top of that list.

> Gum arabic is an important cash-earning crop and conservational crop for deteriorating land. Kordofan produces about 65% of the national gum arabic production. There is a great deterioration in the gum arabic belt due to:
> 1. Drought
> 2. Cutting for cultivation
> 3. Migration of villagers to town
> 4. Fluctuation of prices
> 5. Lack of drinking water in some productive areas.

Moreover, Lamprey (1975) in W. Kordofan along lat. 14°N (northern limit of the study area) observed that, "In the area between Um Badir and Mazrub along lat. 14°N extensive death of *Acacia senegal* (gum arabic tree)." (Figure 5.3)

More likely it was the combined effect of drought and desertification that led to that extensive death of gum arabic trees known as "*Acacia senegal*".

It may be observed from Figure 5.8 that there were certain years in which there was a decline in productivity in the three crops. These years were 1971, 1973, 77, 79 and 1982 (with the exception of groundnut). It could be inferred from this trend that there was a form of severe drought cycle, occurring every two and four years consecutively, if 1983 is included (as perceived by the peasant farmers of E. Kordofan) and as mentioned by Hulme (1984) the cycle trend would be perfect.

In conclusion, it is evident that drought in the years between 1978 and 1982 has seriously affected crop productivity. This drop in productivity occurred not only in the semi-arid areas but also in the savanna region to the south (Al Ayit R.C. of E. Darfur), and it has had serious repercussions on the economy at the regional and the national level. It was evident that the 1982 drought, which came after three to four years of perpetual drought, had a devastating effect on crop productivity both locally and at the regional level. The same trend continued, and resulted in a wide range famine in 1984 (Dobri 1985; Kaplan 1984; Miller 1985). These findings agree with those of Al Saim (1984), Asher (1985), Derrick (1984), Hulme (1984), and Trilsbach and Hulme (1984).

5.3.2 Impact of drought on grain prices

This section is intended to show the impact of drought on grain prices for the period 1978-1982 in both E. Kordofan and E. Darfur regions. A sample of grain prices was taken from the northern and southern part of each region.

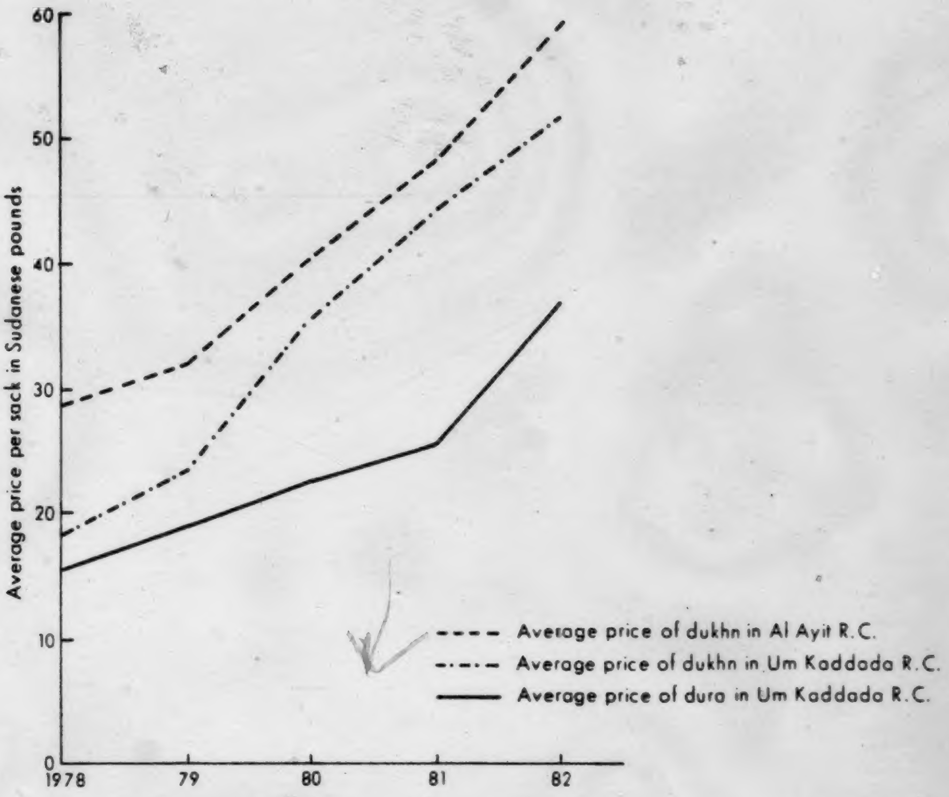
5.3.2.1 Drought and prices of *dukhn* (millet)

As may be seen from Figure (5.9), prices of the main food crops rose continuously since 1978. Price rises may occur both as a result of drought as well as related factors such as supply and demand, marketing systems, and accessibility to transportation. However, without exception, drought played a key role in the rise of prices. During the severe drought of 1984, prices of *dura* (sorghum) increased fivefold at Khartoum (Al Tayib 1984; Asher 1985).

As illustrated in Figure (5.9), prices in E. Darfur show a sharp increase since 1979. Prices reached the highest point in 1982. Particularly in Karoya village prices of *dukhn* (millet) in one year doubled. Between 1981 and 1982 they increased from S£33 to S£67. In Karoya village, prices have increased as many as 3.5 times between 1979 and 1982.

Some differences in prices were found in terms of geographical locations. For example, in the southern parts of Al Ayit R.C. (E. Darfur), prices were different from the northern part of the same region. In the last five years (1978-1982), the average price of one sack of *dukhn* in Gabir (north) was S£54, whereas it was S£31.6 in Karoya (south).

Surprisingly, prices of *dukhn* in some parts of Al Ayit R.C. seemed to be higher than the prices in Um Kaddada R.C.. The reverse would be expected, because Al Ayit is



Source: Field survey (1983)

Figure 5.9 Average prices of dukhn and dura per sack in Sudanese pounds (£) in East Darfur for the period 1978-82

wetter than Um Kaddada R.C. One possible explanation for this is the problem of transportation. The common means of transportation in Al Ayit is by camels, but during harvesting, lorries travel into different parts of the region (Al Ayit R.C.). After harvesting, transportation becomes extremely difficult. People in the region commented on the difficulty of transportation:

> It is easier to travel to Egypt than to Towaisha (from Al Ayit town). It took you only 5 days to be in Egypt, while you need 15 days to reach Towaisha.

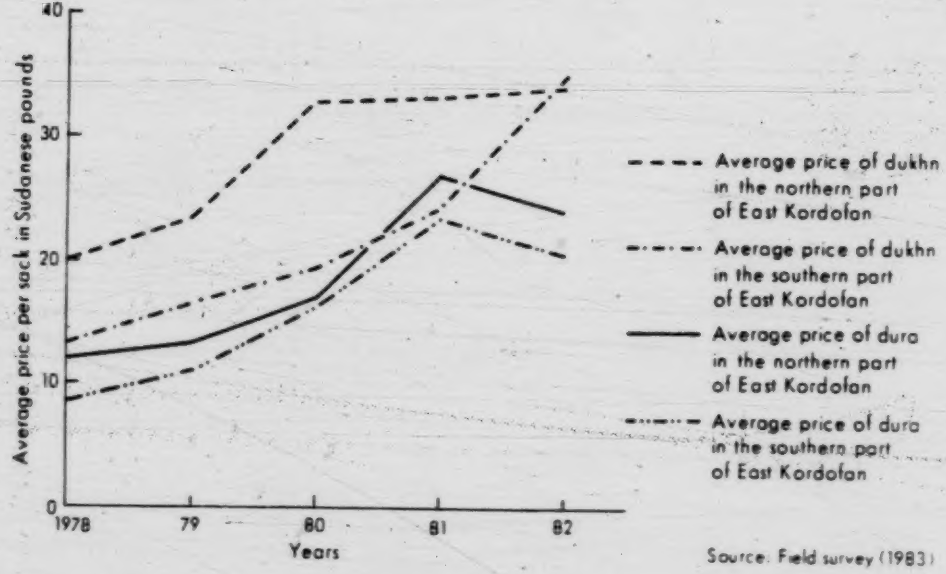
The same applies to Um Kaddada R.C. Prices of *dukhn* were observed to be higher in Abyad than the prices in Al Hilla, both of which are villages in E. Darfur. Prices are higher because grains are brought from the east, such as Kordofan and C. Sudan. The longer the distance goods travel, the higher the prices.

As illustrated in Figure (5.10), prices of *dukhn* tended to increase continuously since 1978 in E. Kordofan. The average price of *dukhn* from 1980 to 1982 in the northern area maintained almost the same rate. In comparison, prices in the south, tended to increase smoothly between 1978 and 1981. Also in the southern part, prices rose by up to 43% from 1981 to 1982. The average price in Kagarat, Al Bahriya and Al Adousa villages (N.W. part of E. Kordofan) were observed to be higher than the rest of the region by S£8-10. One possible reason for this increase was the problem of transportation, since grains were shipped from the southern parts.

In general, prices of *dukhn* rose continuously from 1978 until 1982, which coincides with severe years of drought. Lack of transportation added to the problem of shipment, especially in some areas.

5.3.2.2 Drought and prices of *dura* (sorghum):

The introduction of *dura* 5 years ago into Um Kaddada R.C. in E. Darfur shows the effect of drought in this region. Before 1978, Um Kaddada R.C. seemed to be self-sufficient in *dukhn*, although due to a *dukhn* shortage in 1978 *dura* (sorghum) was



Source: Field survey (1983)

Figure 5.10 Average prices of dukhn and dura per sack in Sudanese pounds (£) in East Kordofan for the period 1978-82

introduced.

Figure (5.9) shows that *dura* was introduced to Um Kaddada R.C. in 1978, and was introduced to Al Ayit R.C. for the first time in 1982. The average price of *dura* tended to increase continuously but smoothly between 1978 and 1981. From 1981 to 1982, it rose 46.2%.

On the other hand, while the average price of *dura* in E. Kordofan increased continuously until 1981, it started to decline again in the northern and the southern parts of the region in 1982 (Figure 5.10). Throughout the period 1978-1982, the average prices in the north remained higher than the south.

In conclusion, drought has caused crop failure which in turn, resulted in a grain shortage. This has led to the rise of grain prices. Moreover, the problem of transportation in E. Darfur had led to a greater increase in the price there than in E. Kordofan.

5.3.3 The effect of drought on animals owned by nomads

Drought has affected both animal resources and animal production. Animal resources refers to camels, cattle, sheep, and goats, while animal production refers to milk and dairy products. The pastoral nomads were asked whether they had lost any of their animals in the last two years. Almost all respondents (98.1%) replied "Yes". Respondents were then asked to state the number of animals they had lost because of drought. Approximately 73.0% of the nomads lost at least one sheep, and most of the respondents lost between one and 10 sheep. More than half of those who lost sheep had lost between one and 20 sheep. About three-quarters of those who lost sheep, lost between one and 30 sheep.

About 33% of the nomads mentioned they had lost goats because of drought. More than three-quarters of them lost between one and 20 goats (Table 4.18). Some 16.4% of the nomads lost at least one camel because of drought, and the majority had lost between one and 10 camels. About 26.6% of the nomads lost at least one cow. Most of those who lost cattle because of drought had lost between one and five cattle. Almost three-quarters of them lost between one and 10 cattle.

When it is considered that most nomads own sheep, goats, camels and cattle the loss of animals due to drought is great. The loss will be greater if deaths due to drought-related disease are considered.

This result suggests that the direct effect of drought on animal deaths was significant. The seriousness of the effect of drought is reflected in comments made by the nomads.

> "Drought killed almost 75% of the animals, and we should sell most of the remainders to buy grains"
>
> "Four or five of the Hwawir possess 40-50 animals. They leave these animals with one of them, and the rest should go and seek work elsewhere."
>
> and
>
> "I had 400 animals before 1981, but by August 1981 I have only 25 animals remaining."
>
> "Two-thirds of all animals between Um Rowaba and the Nile perished, only one-third left."
>
> "People of the north in 'The Kababish, The Kawahla and the Hwawir' areas suffered great losses"
>
> "Each animal sold in order it may save the other."
> "In the summer of 1982 about 75% of the animals vanished"

Findings from this study, complement those from other research. For example, in W. Kordofan in Al Muzroub area, Qotbi (1982) states that:

> In the summer of the year 1981 Al Muzroub area (Figure 1.9), was severely hit by drought. All hafirs dried out by March. Based on the information that we have got from there, between 50 and 70 animals of different kinds died daily. Death of sheep was reported to be more than the other animals. This could be attributed to the fact that sheep were facing tough but difficult circumstances. They drank once every five days. They stayed two days in the pasture and one day on their way to water points. When they reached there they stayed the whole day, and the next day they had to move back to pasture. Because of these unfavourable conditions, animals were getting weaker and could easily be attacked by disease. He further added that percentages of losses of sheep were reported to be 37% and approximately 35% in cattle.

5.3.4 Loss of animals due to disease:

When asked to state the number of animals that had been lost because of disease, many pastoral nomads found it very difficult to differentiate between losses of animals caused by drought and the deaths caused by disease. The difficulty in differentiating between the two stems from the fact that drought and disease tend to occur side by side, especially during severe droughts. Drought, however, weakens animals and increases their vulnerability to disease (Qotbi 1982). Therefore, when the pastoral nomads reported the total loss of their animals because of both factors, the total was divided into two halves and each half was placed in either of the two groups.

Approximately, 63.5% of the nomads had lost at least one sheep because of disease. More than 60% of those who lost sheep because of disease, lost between 11 and 30 sheep. Two diseases were identified as being responsible for most of the sheep deaths. These diseases were *Al Holaa* (*Homonchosis*) and *Abu Fishafeesh* (*Contagious caprine pleuropneumonia*). About one-fifth of the nomads lost at least one goat because of disease. Almost half of them lost between one and 10 goats. Most goats were killed by *Abu Neeni* (*Contagious caprine pleuropneumonia*). About 36.1% of the nomads had lost at least one cow. Almost half of them lost between one and 10 cattle, and the vast majority of those who lost cattle lost between one and 20 cattle. More than one-quarter of the nomads lost at least one camel, and more than half of them lost between one and 10 camels.

In terms of disease, some nomads commented that

> "*Abu Dimaa* (Rinderpest) finished out cattle eight years ago"
>
> and
>
> "Because of disease I have left 15 camels behind me on the road."

Both drought and disease have had a devastating effect on the animal population of the semi-arid areas of the Sudan. Many nomads no longer have large numbers of animals. Some are no longer nomads, and have started to look for other jobs. The findings of this study complement the findings by Asher (1985), Hulme (1984) and Qotbi (1982).

5.3.5 Effect of drought on availability of milk and dairy products in cities

Drought also has had an adverse effect on the availability of milk and dairy products in cities. During the rainy season, nomads from the South (The Hawazma) move northward. They spend time around Al Obeid area during which time they move around Al Obeid streets and sell cheap milk. With this milk, Al Obeid women make homemade cheese. Field survey revealed that in the mid rainy season of the year 1983 herdswomen seldom were seen in the streets. Because herdswomen delivered milk to Al Obeid the price of milk and cheese rose. Invariably, both milk and cheese became unaffordable to many people. Another factor influencing the amount of milk and cheese available resulted from the fact that animals became very weak because of drought, which affected both meat quality and milk productivity. (Plate 5.1)

5.3.6 Selling of jewelry instead of weak animals

In 1982 drought killed many animal and left many weak and unhealthy. The Kababish and the Hwawir were most affected by drought. When the Kababish brought their sheep to the market (Um Dam), they found that their animals could not compete with other sheep, such as the Gawamaa sheep. Abd Al Muhmoud (1983) states that Gawamaa sheep were sold for S£45, whereas the Kababish variety sold for less than one half. (S£17-20).

For this reason, nomads ceased selling their animals. Instead, they brought their inherited jewelry to the market. Nomads value their animals very highly. If they started selling their animals at the prevailing market prices, eventually they would lose them all. Therefore, they thought it would be better to sell their jewelry rather than losing their animals. Jewelry has a high personal value, but animals have even higher personal, social and psychological value. Losing jewelry means losing one of many personal values, but losing animals means loss of identity.

Plate 5.1 Weak cattle gathered in front of the water yard at Um Kaddada

Unfortunately, many of the most affected nomads were not interviewed because they were not in E. Kordofan by the time of the field survey. Some nomads suggested that the most affected nomads lost between 80-90% of their herds. In order to buy grains to feed the remainders, they had to sell jewelry instead of weak animals.

The field trip revealed that the need for grains as a quick relief in order to save the rest of their animals, encouraged nomads to go to many E. Kordofan markets to buy large numbers of sacks of *dura* (sorghum). Consequently, they increased the demand and prices of *dura* at the same time. Some of the nomads remarked that:

> The Kababish grazed all of the available grass and they left us nothing.
> They also have increased the prices of *dura*.

During the severe drought of 1984, more than 40,000 of the nomads (The Kababish, Hwawir, and Dar Hamid) moved to relief camps at Omdurman after they lost all their animals and jewelry (Abd Al Aziz 1984:a; Asher 1985). The trend which started in 1982 ended with a personal disaster on a large scale. This large number of drought victims had to leave their homes devoid of animal wealth and jewelry and had to live in relief camps for almost seven months. In general, the individual nomad to the north of the study area had lost more than 50% of his herd, while to the south about 25%.

5.3.7 Mass out-migration

Migration is a technique that has been undertaken by the people of the Sudanic belt of central and western Africa, when they encountered risk, and uncertainity due to climatic conditions or to satisfy a personal need. Between 1969 and 1983, mass out-migration was taking place in Northern Darfur region in general and Dar Zaghawa and Dar Berti in particular (Adams 1975; Ibrahim and Babiker 1983; Sanosi 1978; The 1983 National Census and Tubiana and Tubiana 1977). The rate of movement increased as the drought intensified. People moved from N. Darfur either to the southern part of the region, or to the other parts of the country. Adams (1975 : 278) stated that

> Disaster in the Sudan has been avoided, not so much by relief programmes as by the movement of the population southwards, unhindered by international frontiers, in which respect Sudan is more fortunate than countries like Niger, because it has a wide north-south spread.

In relation to the situation of Dar Zaghawa (N.W. Al Fasher), Ibrahim and Babiker (1983 : 3) state that

> During the period of 1970-73 the Zaghawa people deserted their villages because of drought. It was found that 470 out of 804 villages were voluntarily evacuated and people moved southward. They established villages in many parts of southern Darfur as well as other parts of the country. 100 new villages were established in the *Gaizan* area (sand dunes) south of Al Fasher.

In the recurrent drought of the 1980s, numerators of the 1983 (Feb.) National Census pointed out that some villages in E. Darfur were totally uninhabited.

> We found that many villages were deserted completely because of drought, which hit this area for the last 3 years. The inhabitants of these villages have gone for ever. Some of them migrated to the south and some found their way to Um Kaddada Town, in which they settled as their new home. The best example of these villages were Um Suttoya and Um Khizunna. Um Suttoya was inhabited by 70 persons (15 householders) and Um Khizunna by 375 (75 householders). They have all left and the buildings are now submerged under the moving sands. (Al Abas 1983).

Some people migrated to the Kordofan region; Sanosi (1978) mentioned that

> Many people of N. and E. Darfur moved to W. Kordofan especially Ghibaish and Suq Al Gamal areas.

Statistically, the 1983 National Census shows that there was a marked difference between the population of Um Kaddada town in 1982 and 1983, and the population of Um Kaddada R.C. for the same period (see Table 5.5).

TABLE 5.5

Population of Um Kaddada and Um Kaddada R.C. in 1982 and 1983

Area	1982 estimation	1983 census	Differences in population	% of the decrease
Um Kaddada Town	7760	6815	945	12.18
Um Kaddada R.C.	45230	39237	5993	13.30
Total	52990	46052	6938	13.10

Source: The 1983 National Census.

As may be seen from Table 5.5, there was a clear difference in the population in both the town and the rural council between 1982 and 1983. The difference for both was calculated at 13.10%. It should be noted that the 1983 census was carried out in February, while the period of drought peaked during May and June of 1983. Therefore, it would be misleading to consider the 13.10% difference as representative of the population difference during the drought peak. This is evident from the field survey in E. Darfur (which coincides with the same period of peak drought), that in most villages, 50-60% of the population had left during the two month drought peak. Given this fact, therefore, 50%-65% should be considered as the true figure for the difference in population for Um Kaddada town and Um Kaddada R.C. between 1982 and mid 1983.

During the 1984 drought, 1.2 million people were reported to be affected in N. Kordofan (Al Ayam Newspaper 1984:c). Some of them moved to Omdurman (to relief camps), others to irrigated schemes such as the Gezira and Er Rahad, and some (mainly nomads) moved to the southern part of the region. However, the number of drought victims that reached the Gezira in December 1984, from both western Sudan (Kordofan and Darfur regions) and eastern Sudan, was estimated at one million. This number increased the population of the Gezira by 50%. Social services were only sufficient to help the original population of the Gezira, and any increase in population would create social and health problems (Hamid 1984).

According to Dobri (1985), by January 1985, the number of drought victims in the semi-arid areas of the Sudan grew to 2.8 million. Most of the drought victims in Kordofan migrated to the south and the irrigated schemes, although some 40,000 migrated to the relief camps at Omdurman. Despite plans to settle and resettle these people from Omdurman and from the irrigated and the southern areas of Kordofan region, many of them were reticent to return to their drought affected areas. The field work in 1983 revealed that many respondents, especially in E. Darfur intended to migrate and reside near the Nile instead.

Pastoral nomads have adopted migration as a flexible strategy to escape dry summers or drought periods. In some cases, moving with weak animals to rich pastures or to water points, was not possible. The field survey revealed that some nomads asked the help of the authorities in Um Kaddada to provide them with trucks in order to transport their animals to water points. Local authorities responded to their cry, but only after half of the nomads' livestock had perished.

In conclusion, the main social problem created by the current drought is that of migration of drought victims to other areas. This social problem manifests itself in the breaking apart of customs and rituals in order to survive. Until 1983, migration by drought victims primarily affected the place of origin in rural areas rather than the destination. However, during the 1984 drought, mass out-migration created a real problem in both the places of origin and destination, and problems for the regional governments also. These finding concur with other studies (e.g., Hulme 1984; Trilsbach and Hulme 1984.)

5.3.8 The effect of drought on the natural resources

Drought also has adversely affected the natural environment of the semi-arid areas. Some examples include intensification of desertification in certain areas, drying up of water sources, the falling of local water tables, the drying up of trees, and the disappearance of some plant species.

Evidence collected during the field trip especially in Um Kaddada R.C. in E. Darfur, suggested that in certain areas years of drought have intensified desertification (Plate 5.2). It is reasonable to assume that not only drought is to be blamed for the desertion of villages, but also desertification. This is particularly true for Um Khizunna and Al Arais. Desertification tended to be severe in and around Um Kaddada town. It affected many buildings on the fringe of the town such as Um Kaddada hospital (Plate 5.3). Sands buried part of the building, forcing the hospital authorities to remove these sands three times during 1982. The author observed that near the buildings of Um Kaddada R.C., an abandoned lorry (2 metres high) was buried completely under the moving sand in a period of only two years.

Not all parts of the town were similarly affected. The northern parts were more affected than the southern parts, since wind carried sands from the north (the southern fringes of the Sahara). For the last three years sands have appeared on top of the hills around Um Kaddada. Unless something is done to hold back these sands, Um Kaddada people seriously need to consider the necessity to relocate their township elsewhere.

The intensity of drought can be traced through the falling of water tables and the drying up of some surface and subsurface wells. As reported in the field survey, underground water in semi-arid areas of the Sudan have been adversely affected by drought. Water tables in Um Kaddada fell seven metres in 1982 and 1983 (Ahmed 1983), indicating how greatly the water supply has been exhausted during the drought period. It also indicates that water recharge is lagging far behind water discharge. These findings support other studies by Trilsbach and Hulme (1984), and Derrick (1984).

Other factors besides drought are contributing factors in the drop in the water table. One factor is that for the first time in many years, Um Kaddada received and nourished thousands of the Kababish and the Kawahla animals while on their way southward. A long time ago, the Kababish signed an agreement with the local authorities not to enter the town. But in

Plate 5.2 Al Arais village in E. Darfur buried under the sands

Plate 5.3 Sands have buried most of the outside fence of Um Kaddada hosp

the summer of 1983, they were allowed to enter because all water stations around Um Kaddada were not functioning. Consequently, the Kababish added an extra load to Um Kaddada water stations, and the rate of pumping increased up to fivefold.

Many wells which used to be perennial sources of water supply have dried up completely. Despite the effort undertaken by local inhabitants to deepen them from time to time, the recharge did not improve and some of the wells have reached the point of complete failure. This is particularly true for some areas like Bit Goda and Yasin wells in E. Kordofan. (Field survey) In W. Kordofan, Qotbi (1982) states that surface and subsurface water was seriously affected by drought.

Drought has had a serious repercussion on the amount of water supply in urban areas. The very low average rainfall has affected the amount of run-off and storage as well. In the city of Al Obeid, which depends entirely on surface run-off during the rainy season, an extreme shortage of water supply occurred during the 1983 summer. A major cause of this shortage was the inability of the reservior to meet consumption needs. Similarly, Al Fasher experienced a serious water problem during the summer every year since early 1960s. One possible explanation for this was the low recharge and the increasing growth of population. The population increased because some people from the the rural areas came looking for jobs and others came to tap water from these cities.

Both drought and desertification had contributed to a deterioration in the physical environment of the semi-arid areas in recent years. Drought seems to be responsible for the drying-up of most of the trees in the semi-arid areas. For example, Al Arais and Abyad areas of the northern part of E. Darfur (Plate 5.4) reveal the extent to which drought has affected the trees.

Drought has a far reaching effect on grasses. Some grasses have disappeared long ago, and some seeds were buried deep under transported soil at depths of between 20 and 30 cm hindering their germination. Rains in recent years failed to reach that depth. Even if grasses were able to germinate with exceptionally high rainfall, the shortage of rain would hinder plants

Plate 5.4 Drought-striken trees near Al Arais

from reaching maturity and dispersing seeds. Suliman (1983) points out that many plant species (more than 15) disappeared in the last few years, after he surveyed some localities in W. Kordofan. This supports the finding of Asher (1985).

Some people in E. Kordofan mentioned that due to the lack of grass, sands and gravels were found in the stomaches of many cattle after they were slaughtered. Cattle graze on relatively longer grasses, and in the absence of these grasses they tend to eat shorter ones. Consequently, sands and small gravels were eaten with these shorter grasses.

Drought also has affected the flora of the mountains. Sirag (1983) has mentioned that most trees and grasses of Jebal Morra in Darfur have dried up in the last few years. This has a serious effect on the production of the famous fruit and pine trees of Jabal Marra. In fact, not only was the vegetation affected, but also springs and small streams that ran downhill suffered as well. Most of the streams dried up or had very small discharges.

In conclusion, drought seriously affected the vegetation cover in many areas in the semi-arid areas of the Sudan. Moreover, the effect both of drought and desertification is very evident in the drying up of trees and the disappearance of some plant species.

5.4 Summary

Drought is not a new phenomenon in the Sudan. Historical records and the field survey showed that the people of the Sudan in general, and of the semi-arid areas in particular, had experienced years of drought and famines in the past. Perhaps the previous drought periods were as hard as the current drought, and some even harder such as the "great famines" of 1684 and 1888-89. In most cases, malnutrition and disease were the immediate result of those years of famines. Recurrent drought has had serious repercussions on crop productivity, animal resources and dairy products, and forced the people of the semi-arid areas to move southward to avoid the effect of drought. Drought followed by desertification has had an adverse effect on the natural resources of the region. Bare soils were exposed to wind, and trees, surface and subsurface water sources have dried up. Groundwater tables have fallen to a serious level, because both discharge and consumption were more than the recharge of wells.

Chapter 6

The Perception of Drought Hazard

6.1 Introduction

Researchers of hazard maintain that the perception of the hazard is important to the adoption of adjustment(Kates 1962, 1970; Saarinen 1966; Sorensen and White 1980; Burton, Kates and White 1968). This point was further illustrated by Porter(1978 : 6), who stated that

> Research which ignores the beliefs, ideas and knowledge of environmental hazards possessed by those affected by the hazards is incomplete and can have unfortunate consequences when its findings are used in planning and decision-making. A perception of environment research strategy can assist in creating meaningful research results. It is not, however, a substitute for other kinds of research based in natural science and engineering. It is simply a way to gain added insight into the subject of environment hazards by attempting to see them through the eyes and in the cultural context of those directly affected by the hazards. There is no presumption that local understanding will prove to be scientifically correct; but the local understanding of hazards is important in its own right, and more frequently than is generally believed, local knowledge and practice prove to have scientific and social validity as well.

Therefore, the local ideas, knowledge, understanding, and attitudes towards environment are considered to play an important part in the adoption of adjustment and the decision-making by policy-makers in formulating proper plans of development.

This chapter includes a discussion of the peasant farmers' and pastoral nomads' perceptions of drought, variations in peoples' perception of the intensity of drought, perception of areas of severe drought by nomads, awareness of drought, role of experience, perception of drought signs and predictibility, and attitude to drought and environment.

6.2 Definition of drought:

Peasant farmers were asked to define drought. The vast majority, 87.6%, replied "lack of rains," while 11.5% mentioned crop failure. The pastoral nomads were asked the same question and it was found that the majority of the nomads(82.7%) defined drought as the lack of grass. Some 13.5% answered it was the lack of rains. Statistically, it was found that there was a significant difference between the peasant farmers and the pastoral nomads in terms of the definition of drought. (Table 6.1)

Reasons for differences in the definitions of drought by the two groups might be related to (1), the evaluation of those factors which most affected the respondents' entire livelihood and economic base, and (2) the interpretation of the term "drought". Drought was perceived by the majority of the peasant farmers as related to rain and water problems, because the lack of rainfall affects plant growth. On the other hand, in some productive agricultural areas people suffer from the lack of water supply (like Al Gafil in E.Kordofan). These factors are supported by the research of Wilken(1982) and Berry et al.(1971).

Drought is given many local names such as *Gafaf, Khareef Kasir* .(broken rainy season), *Sana Kasra*.(broken year), and *Sana Hurgana*. (burned year). The dry spell within the rainy season is called "*Subna*" or *Al Khareef Ingudda*, or "discontinued rainy season."

The vast majority of the pastoral nomads perceived drought as vegetation and crop problems. The nomads were influenced by the meaning of the term *Mahal* or "drought," which literally means the lack of grass. For the nomads the lack of grass more than the lack of water supply was their most serious problem. However, lack of grass might occur not only as a result of lack of rainfall, but also because of the outbreak of fire, or "*Hareeg*." Lebon(1965) and Jefferson(1949), offer similar explanations.

To measure variations in peoples' perceptions of the intensity of drought, resource users (farmers and nomads) were asked whether they thought the current drought increased, decreased, or remained the same. Almost all peasant farmers (97.3%) and pastoral nomads (99.0%) perceived the intensity of drought to have increased.

Respondents were asked why they thought drought had increased. The vast majority of the peasant farmers (70.3%) mentioned that the years of crop failure had increased, 34.9% of the farmers mentioned there was a lack of rain, 18.7% pointed out wind transported sands and buried plants and 13.3% pointed out the drying out of trees. Some 8.1% mentioned an increase

TABLE 6.1

Perception of the meaning of drought

Response	Peasant farmers N	%	Pastoral nomads N	%
Rain and water problems	392	88.3	32	15.4
Vegetation and crop problems	52	11.7	176	84.6
Total	444	100.0	208	100.0

Chi-square = 327.850; d.f. = 1; $p < 0.0$

TABLE 6.2

When did you decide that you were in drought?

Response	Peasant farmers N	%	Pastoral nomads N	%
In the rainy season	369	83.1	124	59.6
Early Winter months	75	16.9	24	11.5
Summer months	0	0.0	60	28.8
Total	444	100.0	208	100.0

Chi-square = 141.089; d.f. = 2; $p < 0.0000$

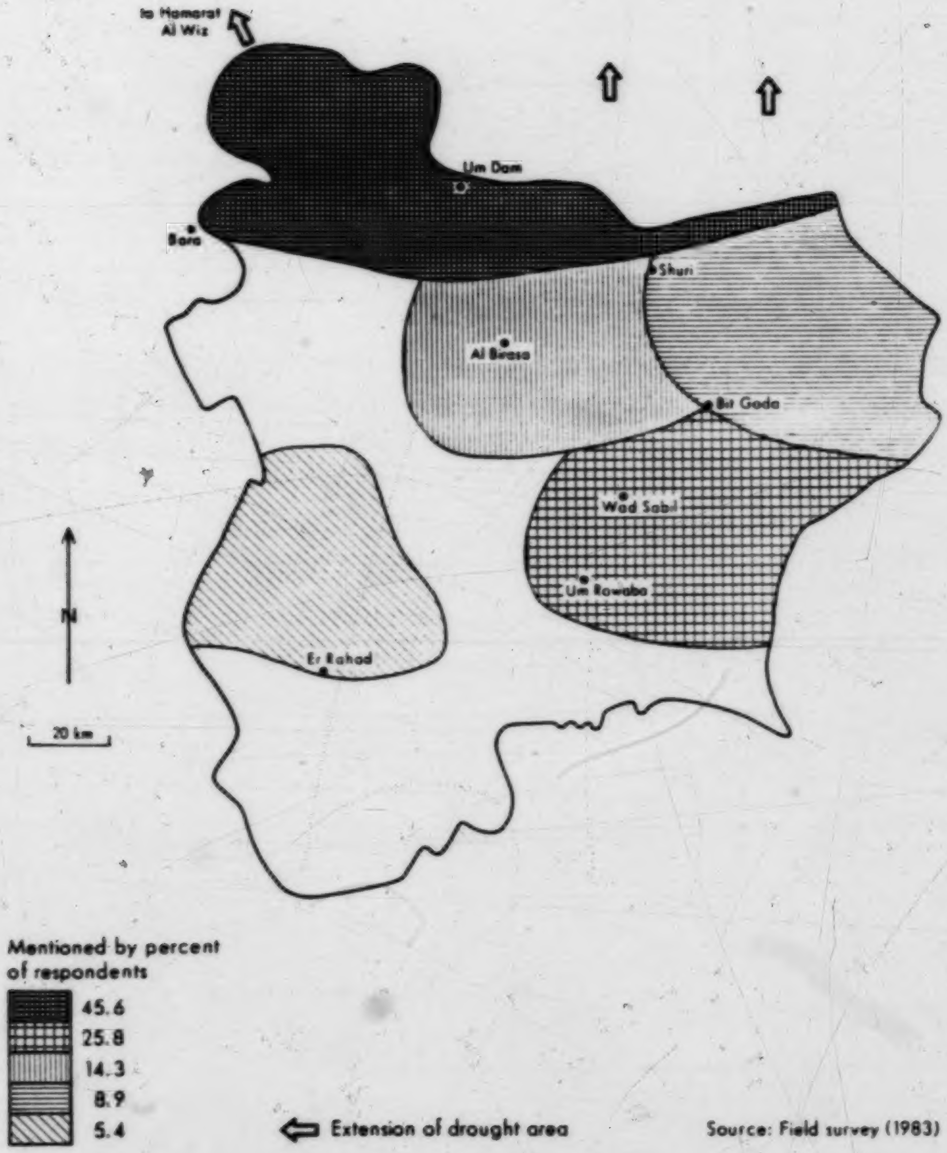
in the number of insects. The decreasing water supply, and the intensification of desertification, also were mentioned. The majority of the pastoral nomads (79.8%) mentioned the lack of grass as an indicator of increased drought, while 17.3% mentioned the lack of rains, and 13.0% mentioned that animals died. One-tenth of the nomads mentioned the repeated years of crop failure. Others mentioned the lack of water supply and the dusty winds which had increased in recent years.

6.3 Perception of areas of severe drought by pastoral nomads.

The pastoral nomads, who moved more frequently than the peasant farmers were asked to point out areas of severe drought. The responses to this question are summarized in the form of maps of both regions (Figures 6.1 and 6.2).

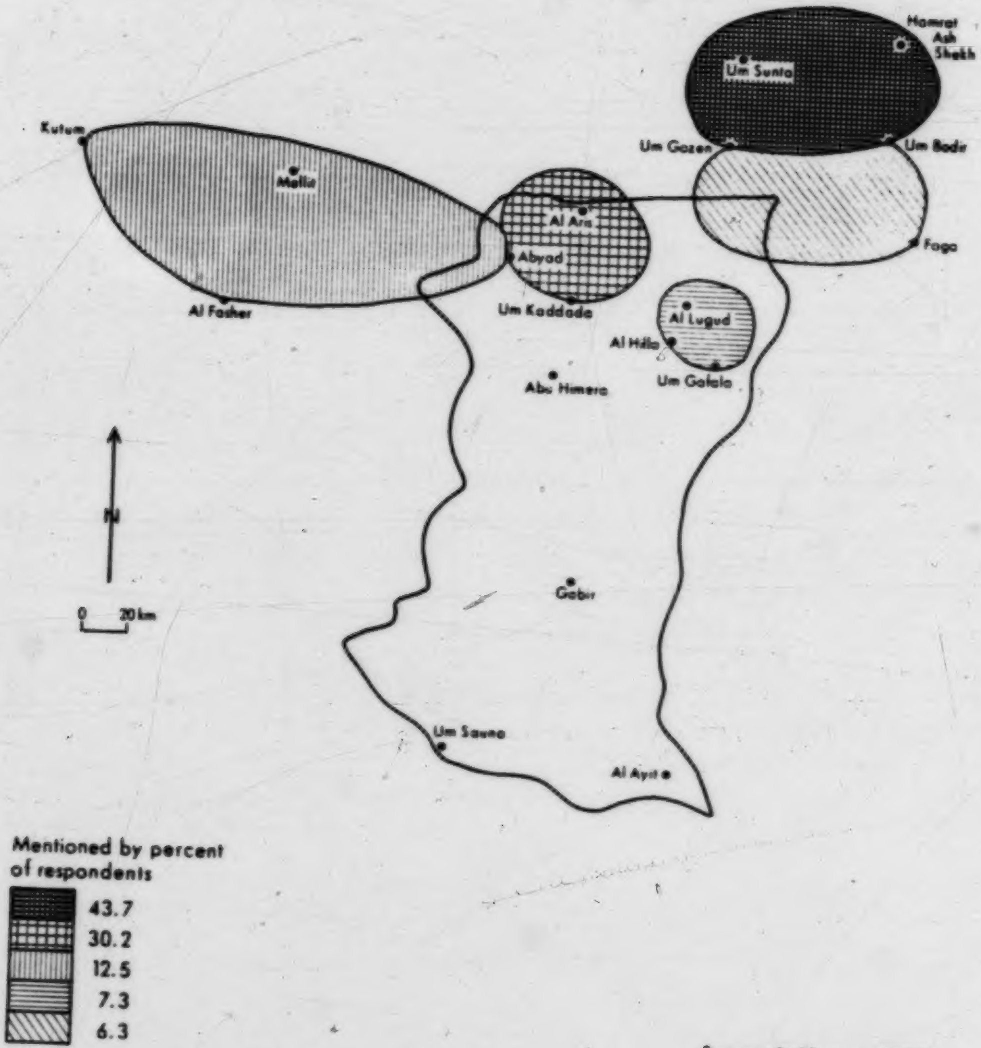
As can be seen from Figure 6.1, almost half of the nomads perceived the northern part of E.Kordofan as being the most severe area of drought. More than 25% mentioned the area delimited by Wad Sabil, Um Rowaba and eastward. Some 14.3% mentioned the area around Al Birasa and west of Shurri and Bit Goda. Almost 9% pointed out Al Baga area, east of Shurri and Bit Goda, while only 5.4% indicated Er Rahad area (mainly the north and the northeastern parts). Lack of grass was the main factor that determined the selection of these areas. In some of these areas, the lack of grass was due to drought, a natural factor, while in other areas drought was due to man-made factors such as overgazing or outbreaks of fire (Field survey 1983). An example of a natural cause of drought is in the northern part of E.Kordofan where drought affected most tribes in that area, Er Rahad, Wad Sabil, Um Rowaba and Al Birasa areas are examples of man-made factors.

An area to the west of the region and in between the selected areas was not mentioned by the nomads as a severe drought area (area in blank). The reason for this was that this area contained *Hashab* trees, or " *Acacia Senegal*" which are protected, and therefore nomads were not allowed to enter the area. This area did not suffer from the lack of grass or overgazing. Another area to the southern part of the region (Nuba Mountains) also was not mentioned


to Hamarat Al Wiz
Um Dam
Bara
Shuri
Al Birasa
Bir Goda
Wad Sabil
Um Rowaba
Er Rahad
N
20 km
Mentioned by percent of respondents
45.6
25.8
14.3
8.9
5.4
Extension of drought area

Source: Field survey (1983)

Figure 6.1 Perception of severe areas of drought by the pastoral nomads in East Kordofan


Hamrat
Ash
Shekh
Um Sunta
Kutum
Mellit
Um Gozen
Um Badir
Al Ara
Abyad
Faga
Al Fasher
Um Kaddada
Al Lugud
Al Hila
Um Gafala
Abu Himera
N
0
20km
Gabir
Um Sauna
Al Ayrit
Mentioned by percent of respondents
43.7
30.2
12.5
7.3
6.3

Source: Field survey (1983)

Figure 6.2 Perception of severe areas of drought by the pastoral nomads in East Darfur

because it was more humid and rich in vegetation, and was a different environment in terms of soil and vegetation.

The pastoral nomads interviewed in E.Darfur, identified certain areas both within and outside E.Darfur as being severely hit by drought (Figure 5.2). Unlike E.Kordofan, the majority of the respondents(62.5%) came from outside the region. Therefore, most of the areas mentioned were outside the region. Most of the respondents(43.7%) mentioned the area between Um Gozen, Um Sunta, Hamrat Ash Sheikh and Um Badir(Western part of Dar Al Kababish) as being only minimally affected by drought. Thirty percent of the nomads interviewed in E.Darfur pointed out the area between Al Arais, Abyad and Um Kaddada, 12.5% mentioned the area demarcated by Kutum, Mellit, Abyad and Al Fasher, 7.3% mentioned the area between Al Lugud wells, Al Hilla and Um Gafala as being affected by drought. One possible explanation for this is that many tribes reside near this area, especially Al Lugud wells, in the summer. Consequently, the carrying capacity of the land falls below the number of animals at that period of the year. Some 6.3% mentioned the area south of Um Gozen and Um Badir to Foga.

Most of the above mentioned areas of severe drought coincide very closely with the northern part which was mentioned by most nomads in E.Kordofan. In fact, all areas north of Latitude 14°N were severely hit by drought, causing most of the tribes there to move to the south. The amount of rainfall in 1982 (Figure 2.9 and 2.11) and 1983 (Hulme 1984) tends to support this. Moreover, the area which was mentioned by 12.5% of the respondents in E.Darfur also was severely hit by drought. This area was subjected to mass out-migration in 1982, 1983 and 1984 (Al Saim 1984; Field survey 1983; Hulme 1984; Tubiana and Tubiana 1977). Comments from local nomads reflect these findings:

> "Are you "the writer" going to E.Darfur to investigate drought? You should first go to Mellit and Kutum where severe drought is"
>
> "Most of the Zaghawa in Kutum moved to the southern part of Darfur because of drought."
>
> and

> "You will be travelling for miles and you never see a green tree ... All trees dried up and fall down."

The pastoral nomads were asked whether they had been to the perceived areas of severe drought. The overwhelming majority (91.3%) answered "Yes", while only 8.7% answered "No". The respondents who answered "Yes" were asked to specify when they had been in those areas. Most of the respondents (30.5%) mentioned June 1983. Twenty-five percent pointed out April 1983, and 16.3% answered May 1983. This shows that three-quarters of the respondents were in the severe areas of drought between April and June 1983. The field survey revealed that these months coincide with the peak periods of drought. However, 13.2% mentioned the year 1982, and 10.0% mentioned February and March of 1983. Only 4.7% mentioned 1981. Because the percentage of the nomads who mentioned 1981 and 1982 was very small, it may be inferred that according to their perception and experience with areas of severe drought, they avoided those areas in 1983. This result indicates that the nomads had a clear idea about the areas of severe drought and the time when they were last there. They responded to those unfavourable conditions by moving out of those areas during the times mentioned.

6.4 Awareness of drought

> Awareness or knowledge of a hazard is roughly what is included in the term "perception," as used by hazard researchers (Mileti et al. 1975:23). The term would include attitudes, ideas, or feelings as well as the individuals understanding of the character and relevance of a hazard for self and/or community (Saarinen 1976, 1982 : 2).

Saarinen's definition of awareness will be adopted in this study, which in a very broad sense means the knowledge of the hazard, which in this case is drought. Both the peasant farmers and the pastoral nomads were asked to identify when they decided they were experiencing drought. As may be seen from Table 6.2, there was a significant difference between the two groups. The majority of the peasant farmers and the pastoral nomads felt they were experiencing drought during the rainy season. Sixty percent of the peasant farmers decided they were experiencing a period of drought at the end of the rainy season (end of September and the beginning of October). Up to that time they were always hoping for better rainfall. According to their experience with rainfall and local tradition, only the blessed people received rainfall at that time. Some 17.3% felt drought occurred at the middle of the rainy season. Few (5.4%) felt drought began at the beginning of the rainy season. These results reflect the high degree of awareness of drought by farmers and their constant optimism about rain. This optimism can be explained by their Islamic religious beliefs, which emphasize optimism about rain. It is also related to the idea that it is difficult to decide when drought starts and when it ends (Coughlan et al. 1979; White and Haas 1975).

Some 16.9% of the peasant farmers compared with 11.5% of the pastoral nomads decided they were in a drought period in the early winter months (November and December). Twenty-nine percent of the pastoral nomads compared with none of the peasant farmers mentioned drought occurred in the summer months. These nomads were unable to fin[illegible]ss for their animals in the summer, and consequently decided that they were experiencing drought at this time. It may be concluded that the lack of rainfall is the most obvious problem for the peasant farmers, while the lack of grass is the prime problem for the pastoral nomads.

6.5 Advantages and disadvantages of farming in the study area

The peasant farmers were asked about the advantages and the disadvantages of farming in their area. The vast majority of the respondents (85.6%) mentioned the availability of land, whereas more than 12% pointed out the fertility of the soil. Six respondents (1.4%) mentioned that agriculture was their profession, and they did not know any other profession. This suggests that availability of land, land attachment and inability to pursue other means of livelihood might explain why people reside in a hazard-prone area. These findings confirm some other findings (e.g., Ibrahim 1981; Jackson and Mukerjee 1974; Porter 1978; Turnbull 1972).

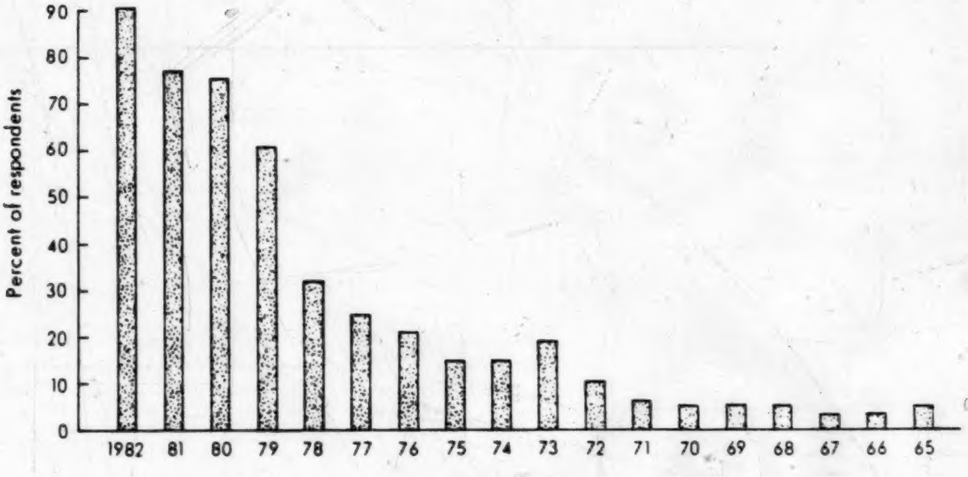
The peasant farmers and the pastoral nomads were asked to identify the main agricultural problems. All peasant farmers and the majority (58.7%) of the pastoral nomads placed drought at the top of the list. Birds were mentioned by 81.1% of the farmers, and by 32.2% of the nomads. Desertification was mentioned only by 0.5% of the peasant farmers and none of the nomads.

Wind was a problem for 71.3% of the peasant farmers and none of the nomads. Wind buries plants and breaks the stems of ***dukhn*** and ***dura*** at the end of the rainy season. Some other peasant farmers perceived wind as an advantage, especially when the new plants appear above the surface three inches or so. At that time the termite attacks the plant but the wind, by shaking the plant, tends to remove the termite. Locusts were perceived as a problem by almost 60.0% of the farmers and 22.1% of the nomads. Rodents as a problem were pointed out by 35.1% of the farmers, and 13.0% of the nomads.

6.6 Experience of drought

Both farmers and nomads were asked whether they had experienced drought during recent years. All respondents indicated having experienced drought. Both farmers and nomads were asked to indicate the last time they had experienced drought. No significant difference was found between the two groups. The overwhelming majority of the farmers and the nomads had experienced drought in 1982. Few experienced drought in 1981 and 1980 (Table 6.3). These variants in response might be explained in part by localized rainfall characteristics in the semi-arid areas (Hammer 1972; Hulme 1984; Trilsbach and Hulme 1984), and differences in perception between individuals.

The peasant farmers also were asked to list the years in which they had experienced drought. The responses to this question are presented in Figure (6.3). As can be seen from the graph the peasant farmers mentioned all the years from 1965 to 1982 as drought years. It was noticed that the percentage of the peasant farmers who experienced drought tended to increase steadily from 1976 until 1982. Interestingly, these perceived years of drought were confirmed meteorologically through other studies (e.g., Berry 1984; Hare 1984; Hulme 1984; Nicholson 1983; Trilsbach and Hulme 1984). It is also observed that since 1979, the percentage of those



Source: Field survey (1983)

Figure 6.3 Perceived years of drought by the peasant farmers

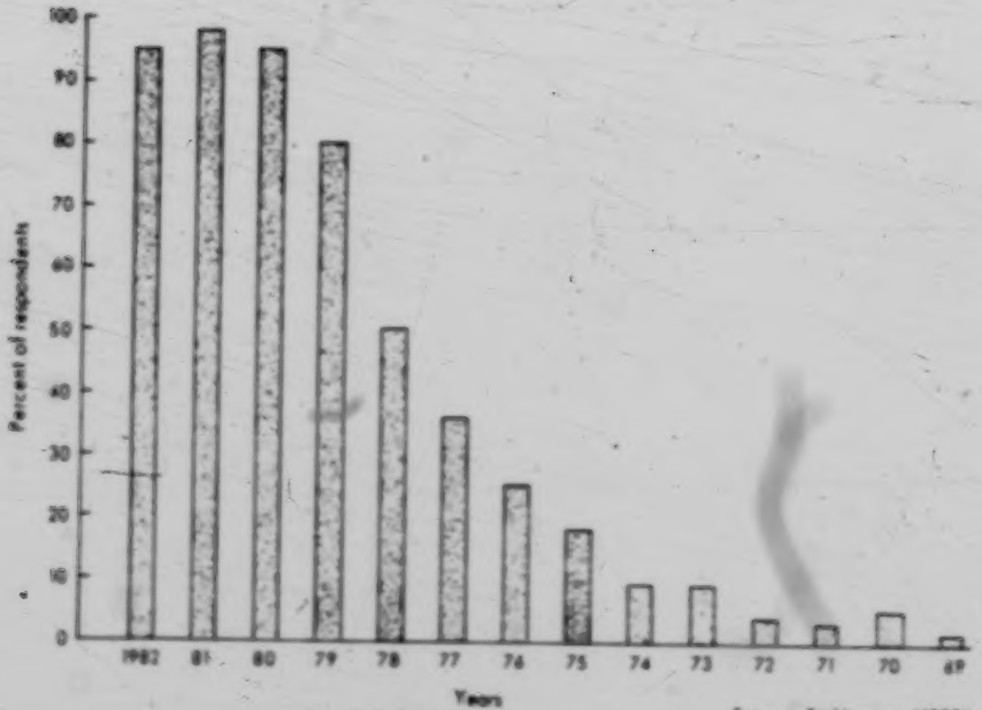
who experienced drought had increased markedly. Al Saim (1984) and Hulme (1984), confirm this finding. Hulme (1984), who analysed the rainfall at some stations for many years in the belt of the study area (12°N-14°N), came to the conclusion that the years 1979-1983 were as dry as 1969-1973.

It can be noted that although the period 1969-73 was known as the severe years of the famous Sahelian drought, farmers have forgotten it, while they remembered the recent drought more vividly. Only 1973 was seen as a more severe drought year than the current drought, probably because people suffered great losses in the 1973 drought.

It may be seen in Figure 6.3 that the percentages of the peasant farmers who experienced years of drought is negatively correlated with time. This suggests the percentage of the respondents decreases as we move through past years. This in part has something to do with memory, and memory fades with time. Another factor may be the good perception of the respondents in terms of years of drought which is confirmed meteorologically through some other studies carried and in the study area. (e.g., Al Saim 1984; Hulme 1984; Trilsbach and Hulme 1984). It could be concluded that the peasant farmers had a clear perception of the years in which they experienced drought, and their memory in relation to these years is remarkably sound.

Generally, the nomads' responses to the same question of drought experience seemed to be similar to the answers given by the farmers. Since 1974 the percentage of the nomads who had experienced drought increased steadily (Figure 6.4). One similar feature in the responses of both the farmers and the nomads is that they rated the years from 1979 to 1982 as very severe drought years. As mentioned before this was confirmed meterologically, Figures (2.8; 2.11), and it is in agreement with the work of Hulme (1984) and Al Saim (1984). The years 1970 and 1973 also were rated as drought years higher than the surroundings. Both nomads and farmers perceived 1973 as a year of severe drought.

There is an on-going debate among hazard researchers with regard to the relationship between experience and adoption of adjustment. One assumption is that experience will increase



Source: Field survey (1983)

Figure 6.4 Perceived years of drought by the pastoral nomads

hazard awareness and greater awareness may lead to behavioral changes (e.g., Saarinen 1982 : 3). Jackson and Burton (1978), admitted the importance of experience, but it was not considered a sufficient stimulus for action. Some other studies found the importance of experience at the preparedness level. This was especially true for earthquake hazard (e.g., Jackson 1974; Mileti et al. 1975 : 18; Turner et al. 1980), but this was not found to be the case for hurricane hazard (Wilkinson and Ross 1970). Such situations were explained by Mileti et al. (1975), who stated that the general tendency would seem to be to underestimate the threat of the hazard.

As far as this study is concerned, peasant farmers and pastoral nomads have had a good deal of intensive experience with drought hazard in the semi-arid areas of the Sudan during the last two decades. Therefore, the findings of this study suggest that extensive experience with drought motivated the people to adopt adjustments to drought hazard.

6.7 Perception of drought prediction

The peasant farmers and the pastoral nomads were asked whether there were signs of drought. As can be seen from Table 6.4, slight differences were observed between the two groups. Almost half of the peasant farmers compared with almost sixty percent of the pastoral nomads answered "Yes." In contrast, 23.2% of the farmers and 18.3% of the nomads answered "No." Almost one-third of the farmers and one-quarter of the nomads had no idea.

The main purpose behind this question was to investigate what kind of intuitive warning system has been developed by the people of the semi-arid areas. The question appealed to their past experience, knowledge of the environment, observation of changes that occurred in the physical environment around them, their feelings, thoughts, ideas, beliefs, and the whole structure of their psychological make-up.

The respondents who answered "Yes" were asked to point out signs of drought. It should be mentioned that the answer offered by nearly all respondents was "everything is in the

TABLE 6.3

When was the last drought?

Response	Peasant farmers N	%	Pastoral nomads N	%
1982	410	92.3	188	90.4
1981	25	5.6	18	8.7
1980	9	2.0	2	1.0
Total	444	100.0	208	100.0

Chi-square = 2.975; d.f. = 2; $p < 0.2259$

TABLE 6.4

Are there any signs of drought?

Response	Peasant farmers N	%	Pastoral nomads N	%
Yes	198	44.6	123	59.1
No	103	23.2	38	18.3
Don't know	143	32.2	47	22.6
Total	444	100.0	208	100.0

Chi-square = 12.163; d.f. = 2; $p < 0.0023$

hand of ***Allah*** (S.T.)",[1] after that they mentioned the signs which they thought preceded the drought. These signs as presented in Table (6.5) included a very warm wind blowing sands from the north-east which buried and burned plants at the beginning of the season (dry wind from the Sahara). This wind is known locally by "*Guggaga*". About 12% of the responses mentioned the lack of rain at the beginning of the season, 9.9% mentioned the appearance of Venus from the east, and approximately 8% of the responses indicated the scarcity of rain at the pre-season (May and June). The infestation of insects and rodents at the beginning of the rainy season was mentioned by a small number of the farmers. However, the relationship between drought and infestation of insects and rodents was not clear. It was not clear whether the farmers meant that the lack of rain created insect and rodent problems, or that because of drought, crops would be attacked by insects and rodents. If the latter is true, this may alter the meaning of drought as a crop failure rather than the lack of rainfall. Three percent of the respondents indicated that there was a cool wind before the rainy season from the south-west. The peasant farmers explained this sign by saying that rain fell some distance to the south and they were only receiving a partial effect of it, that is, the "cool wind." In a sense, this answer agrees with the previous statement, "No rains in May and June." However, the contrast of the warm wind from the north and the cool wind from the south, and being able to point them out as signs of drought, may indicate the ability and awareness of the peasant farmers to observe the changes in wind temperature and direction, and to consider these as early warnings of drought. Although not clear, the relationship between the perception of wind changes and drought may be deemed to be the result of the Westerlies expansion southwards which brings more warm wind from the Sahara southward (Bryson and Murray 1977) or may be related to temperature inversion "cool wind". It is beyond the scope of this study to try and find an explanation of the relationship between the wind-related signs of drought and drought itself. What is important is that these signs are perceived by the farmers as early signs of drought.

---

[1] Almighty God

TABLE 6.5

Perceived signs of drought by the peasant farmers

Signs of drought	N	%
Very warm wind blowing sands from N.W. at the bury and burn plant beginning of the - season.	52	11.7
Not much rains at the beginning of the season.	51	11.5
Venus appears from the east.	44	9.9
No good rains in the pre-season (May & June)	34	7.7
Infestation of insects & rodents at the beginning of the rainy season	17	3.8
Cool wind before rainy season from S.W.	15	3.4
If trees didn't turn to green before rainy season	14	3.2
Dreams of dog or cat bites	7	1.6
No good rains at the end of the rainy season	6	1.4
Winter was not very cold this year	1	0.2
Dream of left leg broken	1	0.2
Other	10	2.3

* Respondents were allowed to give more than one answer.

Some 3.2% of the responses observed changes which took place on trees between one season and another. Dreams of dog or cat bites or breaking of the left leg were also mentioned by the respondents. These dreams may be interpreted as bad luck, which somehow may be connected with drought. Few responses (6) pointed out the lack of rains at the end of the season. Temperature also was mentioned as an indicator of drought. This sign was mentioned by more nomads than farmers (Table 6.5). They were referring to the winter that preceded the rainy season. If the winter was cold it was taken to indicate a good rainy season, but if it was a mild winter, this was interpreted to indicate drought in the forthcoming year. Other perceived signs of drought include cool soil, discontinued rains, and death of animals.

The pastoral nomads gave responses similar to those of the peasant farmers. The pastoral nomads emphasised the lack of rain at the beginning of the season, the appearance of Venus from the east, and changes which took place on trees between one season and another (Table 6.6) as indicators of drought.

In conclusion, it can be said that all of the above mentioned signs of drought are related to the changes that occur in the natural environment. For example, the amount and time of rainfall, direction and temperature of wind, appearance of Venus, changes that appear in trees, the lack of grass, soil moisture and temperature. Few emphasized bad luck associated with dreams.

With these signs in mind, the peasant farmers and the pastoral nomads were asked whether there would be drought in that year. There was a significant difference between the responses of the two groups (Table 6.7). About one-fifth of each group answered yes, and 55.1% of the farmers compared with 70.2% of the nomads either said "No" or "Don't know." One quarter of the farmers compared with 8.2% of the nomads answered "God knows". This may indicate that the people always remain optimistic about the rains.

Respondents who thought there would be drought that year (1983) were asked to state the reasons for their views. The majority of the farmers (69.5%) and the nomads (75.6%) noticed there was not much rain at the beginning of the rainy season. More than 19% of the

TABLE 6.6

Perceived signs of drought by the pastoral nomads

Response	N	%
Not good rains at the beginning of the rainy season (July)		
If venus appears from the east	50	24.0
If trees didn't turn green before rainy season	45	21.6
Cool air before rainy season	18	8.7
Not good rains in May and June or come and stopped	11	5.3
Wind instead of rains at the beginning of the rainy season	11	5.3
Lack of grass at beginning of season	11	5.3
If the winter before rainy season was not severe.	8	3.8
No good rains at the end of the rainy season	7	3.4
No dew in the grass	2	1.0
	1	0.5

* Respondents were allowed to give more than one answer.

TABLE 6.7

Do you think there will be drought this year?

Response	Peasant farmers N	Peasant farmers %	Pastoral nomads N	Pastoral nomads %
Yes	92	20.7	45	21.6
No	176	39.6	100	48.1
Don't know	69	15.5	17	22.1
God knows	107	24.1	46	8.2
Total	444	100.0	208	100.0

Chi-square = 24.800; d.f. = 3; $p < 0.0000$

farmers mentioned that the dusty winds burned and buried plants, while 17.8% mentioned the sparsity of grass. Eight percent of the farmers compared with 4.4% of the nomads replied that the rains of May and June were not good. Few mentioned the appearance of Venus from the east. Some of their comments reflected what they felt about some signs of drought:

> "Don't you see wind everywhere and no rains? ***Allah*** (S.T.) knows, but this is a sign of drought."
>
> "In the past when rains were good you wouldn't find this wind, and now it is found everywhere and no rains."
>
> and
>
> "Do you want to know whether there will be drought this year or not? Look at this bare land. Now we are in the middle of the rainy season (August) and as you see there is no grass - isn't that a drought?"
>
> "Look at these trees and bushes. Do you see even one green leaf on them? In the past at about this time, all trees and bushes were green and our animals ate from them."

Alternatively, the respondents of both groups who answered there might not be drought that year, were asked to point out the reasons that led them to believe that. The data in Table 6.8 indicate that the majority of the peasant farmers who felt there would not be drought that year also stated that they had experienced a good rainfall at the beginning of the season. This response, however, coincides with a largely held local tradition which states "***Al Khareef Al lyin min tabashiro byin***", which means "The good rainy season can easily be seen from its early good rains (in May, June and July)" The respondents were very much aware of the fact that it was not enough to have good rains at the beginning of the season to keep away the threat of drought; they always raised the fear of "poor" rains towards the end of the season. That was reflected in their comments.

> "The beginning of the rains was good. If it continues like this, sure we will have a good rainy season."
>
> "***Wash AlKhareef Koyis In Sha Allah Yatim***: The beginning of the rainy season is good, may ***Allah*** (S.T.) complete it."
>
> and

TABLE 6.8

Reasons stated by the peasant farmers as to why they thought there might not be drought that year (1983)

Response	N	% of sample	% of responses to the question
Rains were good at the beginning of the season	113	25.5	64.2
Venus appeared from the west	30	6.8	17.0
Good rains at pre-season (May and June)	7	1.6	4.0
Trees were getting green prior rainy season	4	0.9	2.3
I dreamed of eating very much and I was happy	4	0.9	2.3
Warm air came from S.W. before rainy season	3	0.7	1.7
Not much wind blowing sands that bury plant	2	0.5	1.1
Other (Just a feeling, air temp. is very high)	13	6.3	7.4
Total	176	39.6	100.0

> "Up to now *Al Khareef* is good. If we get one more rain or two our season will be good."

This concern for rain was confirmed meteorologically by Hulme (1984), who stated that June of 1983 was unusually wet. His analysis concurs with the perceptions of the people, but the people's perception did not extend beyond "hoping for a better season." In fact, Hulme (1984) reached the conclusion that 1983 was the driest year in this century in north-central Sudan (Lat. 12°N-16°N). Differences between those groups who were and those who were not pleased with rains at the beginning of the season may be explained by the differences in their perception and the variability of rainfall as well.

Seventeen percent of the peasant farmers did not think there would be drought that year, because Venus appeared from the west. This answer is related to a local tradition which states that if the star "Venus" appeared from the west "before and during the rainy season" the ground storage would be filled with grains. "*Um Kheir Kan Zaharat min Gharib Al Matmora Karib*" The name of Venus in Arabic is "Al Zahra", but the people in the study area gave it another name, which is "*Um Kheir*" "the star which brings good." It should be mentioned that the people realize that it is not Venus that brings rains, but *Allah* (S.T.). They only feel optimistic with the appearance of Venus from the west. The remainder of the respondents had different points of view which related to the perceived signs of drought (Table 6.5 and 6.6) but interestingly, 4 respondents (2.3%) mentioned a dream contrary to dog or cat bites or breaking a left leg. They dreamed of eating a great deal until they felt that their stomachs were full and that they were happy. This, however, may be interpreted as a sign of good luck.

The pastoral nomads were asked the same question. Similar to the peasant farmers, more than 80% of the nomads who thought there might not be drought that year (1983) mentioned the good beginning of the rainy season and the appearance of Venus from the west, while 12.0% mentioned that trees had fruits and turned green in May and June (Table 6.9).

A comparison between Tables 6.8 and 6.9 revealed that both the farmers and the nomads perceived the signs of drought similarly. They placed emphasis on the good rains in

TABLE 6.9

Reasons stated by the nomads as to why there might not be drought that year (1983)

Response	N	% of sample	% of responses to the question
Rains were very good at the beginning of the season	48	23.0	48.0
Venus appears from the west	34	16.3	34.0
Trees had fruits and turned green in May & June	12	5.8	12.0
It was a very cold winter this year	2	1.0	2.0
Rains were good in May and June	2	1.0	2.0
Warm air from S.W. before rainy season	1	0.5	1.0
Increase of humidity in the air & temperature is high	1	0.5	1.0
Total	100	48.1	100.0

May and June and the beginning of the rainy season, and also the appearance of Venus from the west as indicators of a remote possibility of experiencing drought in that year (1983). The Nigerian farmers pointed out some of these signs, as well as a shift in wind pattern, and rising heat as a sign that rain is near, but not as a sign of good or bad rainy seasons (Oguntoyinbo and Richards 1978).

6.7.1 Next event

Contrary to the findings of Wilken (1982) in Lesotho, the peasant farmers of the Sudan never give an opinion about the timing of the next event. Although there was no written question on the survey about the next event, some of the farmers misinterpreted the questions related to the signs and frequency of drought. They thought they were being asked when the next drought would occur. It was found that the immediate answer for this assumed question was that "I don't know, this is something in the hands of *Allah* (S.T.). No one would dare to enter into the knowledge of *Allah* (S.T.).

In contrast, with reference to the next event, Wilken (1982 : 34) stated that:

> with few exceptions, specific response fell within three years of the survey period. By far the majority of these indicated the current (1978) or next (1979) cropping season. In fact, if these are added to the 252 (28%) "comes every year" responses, it would appear that the average Lesotho farmer expects some if not all adverse events every year.

Considering Wilken's statement "comes every year", it seems that the farmers of Lesotho agree with those of the Sudan in that expression when they were asked about years in which they experienced drought, especially in the last four or five years (1978-1982). The difference between the two was in the meaning of "comes every year." While for the Lesotho farmers this answer may imply some future implication (foretelling the future), for the Sudanese farmers it refers only to the past years.

In conclusion, examination of the above perceived signs of drought revealed that most of these signs are based on observations of the changes that occurred in the natural environment, before the rainy season (May and June), or during the season. These perceived signs will be interpreted as feelings or hopes about that particular season. These are feelings and hopes alone, and they never go beyond that to predicting the future, because this will contradict their strongly held religious beliefs. A strongly adhered to belief is that anything dealing with the future is beyond the control of human beings; that is, "No one knows what is going to happen in the future except *Allah* (S.T.)."

6.7.2 The signs of drought and the immediate action

The perceived signs of drought pose an important question; to what extent do these signs help in an immediate action? The answer for this question cannot be treated separately from the on-going debate among hazard researchers about the relationship between the warning system and adoption of adjustments. As far as the relationship between the signs of drought and immediate action is concerned, there is no readily available answer for this question. But there are some points which may be of relevance to the answer.

These signs are interpreted as feelings about the rainy season and feelings differ from one person to another. Alternatively, there is a local tradition which says the farmers always depend on *Allah* (S.T.). In this instance the farmers said they never gave up hope, and even to the end of the season they were expecting one last good rain. As mentioned previously, people always remained optimistic about the rainy season. The relationship between the perceived signs of drought and immediate response is not clear, except in a very few cases. Evidence from the field survey (mainly Um Kadada R.C. in E. Darfur) revealed that some peasant farmers left their farms at the beginning or at the mid rainy season, when it became clear to them that there was no hope of avoiding drought. They took that action, because even if they received good rains afterwards, it would be too late for the crops to reach maturity.

Alternatively, this may not be the case for the pastoral nomads who continuously were searching for grass and water.

6.8 Attitude towards the environment

Having experienced many years of drought, both the peasant farmers and the pastoral nomads were asked a question in order to examine their attitudes towards their environment. The question was intended to reveal how they felt about their professions in that "hostile" environment. They were also asked what they would invest in if they had enough money. From the data presented in Table 6.10, it can be seen that there was a significant difference between the peasant farmers and the pastoral nomads. It was noticed that more farmers than nomads wanted to change their profession. More than half of the peasant farmers wanted to invest their money in animals, "which is basically the nomads' profession," whereas the vast majority of the pastoral nomads preferred their own profession, that is, "increasing their herds." More than 19% of the farmers compared with 11.5% of the nomads stated that they would like to invest more money in farming, while 15.3% of the farmers compared with 3.8% of the nomads wanted to combine both animals and cultivation. More than 10% of the farmers compared with none of the nomads wanted to invest their extra money in business.

These results indicate that the peasant farmers developed some interest in keeping animals rather than cultivating more crops. Other choices they mentioned were the combination of both animals and cultivation, or to participate in business. In contrast, the pastoral nomads prefer rearing more animals or cultivating crops besides keeping animals.

The vast majority (80.9%) of the farmers preferred to keep animals because (1) animals increase in number and they are much more profitable than crops, and (2) the combination of animals, business, and crops will act as security against crop failure. Few (2.9%) wanted to keep animals for more milk and cash. Seven respondents (1.6%) stated that they would like to combine both animals and crops because of cash and to subsist themselves. It may be said, therefore, that the main factors behind this change in attitude from cultivation of crops to rearing of animals were economic (the need for cash) and environmental factors (security against crop failure). The remainder, emphasised cultivating more crops either alone, or combined with business. It may be inferred from this result that the attitude of this small

TABLE 6.10

If you have enough money what thing would you like to invest in?

Response	Peasant farmers N	%	Pastoral nomads N	%
Animals	243	54.7	172	82.7
Cultivation	86	19.4	24	11.5
Combination of animals & cultivation	68	15.3	12	5.8
Business	47	10.6	0	0.0
Total	444	100.0	208	100.0

Chi-square = [illegible], d.f. = 3, $p < 0.0000$

proportion of the peasant farmers towards cultivation and the environment remained basically the same.

Alternatively, the vast majority of the pastoral nomads preferred their main profession, only a few wanted to become involved in agriculture because nomadism was the only profession they knew. It may be inferred that the attitudes of the nomads towards the environment remained the same before and after those years of drought.

6.9 Summary

This chapter investigated the perceptions of drought hazard by peasant farmers, and pastoral nomads. Significant differences were found between the peasant farmers and the pastoral nomads in regard to the definition of the term "drought". While the vast majority of the farmers defined drought as a lack of rainfall, the nomads defined it as the lack of grass. However, nearly all of the farmers and the nomads perceived drought to have increased in recent years, and meteorologically this has proven to be true (Nicholson 1983; Hulme 1984). Evidence for this was given as continuous crop failure, lack of rainfall and grass, drying out of many water sources and trees, increasing wind which buried and burned plants, intensification of desertification, increased animal deaths, and mass out-migration. Areas of severe drought were pointed out by nomads to occur (1) in the northern parts of the study area, and (2) in areas of overgrazing around water points, throughout the study area.

Farmers and nomads were very aware of drought, and it was perceived by both groups as their first problem. The majority of both groups recognized drought during the rainy season as a lack of rainfall, and some nomads regarded drought during winter and summer as a lack of grass. All the peasant farmers and the pastoral nomads indicated that they had experienced drought. The last four or five years (1979-1982) were pointed out by both groups to be the worst years of drought. This result was confirmed meteorologically by Hulme (1984).

Through observation of the environmental changes prior to and during the rainy season, the farmers and the nomads have developed some patterns about the upcoming rainy season; that is, whether it might be godd or bad. These observed changes include air and soil temperature, wind direction and temperature, the amount of rain in May and June and the beginning of the season (July), the colour of trees and bushes in the pre-season (yellowish or green), air and soil moisture (humidity and dew), and the coldness or mildness of winter. Coupled with these physical changes, there were dreams, such as dog or cat bites or the breaking of a left leg, which were interpreted as bad luck. On the other hand, there were good dreams such as eating too much, which was interpreted as good luck. All of these changes in the physical environments and the dreams were interpreted as portents or hopes about the rainy season in question. In most of these cases the majority of the peasant farmers and the pastoral nomads seemed to be optimistic about the rainy season no matter how bad it was in the beginning. In this respect they were influenced to a large extent by their religious beliefs. Moreover, the relationship between these perceived signs of drought and the immediate response is not yet clear, but some farmers deserted their farms when they did not receive good rains at the beginning of the season. It was found that the economic and environmental factors motivated the peasant farmers' attitude towards cultivation. They would prefer so keep animals and work in business instead of cultivation. Alternatively, the nomads' attitude towards animals and the environment remained the same.

Finally, it may be concluded that the inhabitants of the semi-arid areas of the Sudan have acquired a good deal of knowledge and understanding about drought hazard. Such knowledge was based on their awareness and experience since they have been living with persistent drought for the last two decades. They also have developed some ideas, feelings, beliefs and attitudes about drought hazard. In turn, all of these cognitive processes have resulted in an accurate perceptions of drought hazard, which influence adoption of adjustments. This issue is taken up in the following chapter.

Chapter 7

Adjustment to Drought Hazard

7.1 Introduction

This chapter intends to investigate (1) adjustments to drought hazard by farmers and nomads, (2) the relationship between the perception of drought and adoption of adjustments, and (3) the relationship between attitudes and beliefs and how they affect human spatial behaviour (adjustment).

In this chapter the following will be discussed : preparation for drought, response to the last drought, perception of adjustment, specific adjustments, interchanging and other adjustments, attitude towards adjustments, interaction between the farmers and the nomads, adverse effects of adjustment, assistance received during periods of drought, and summary.

7.2 Definition

The term "adjustment" is used in this study to mean the methods that were adopted by the individuals, groups and communities to cope with drought in the period before and during the event.

7.3 Preparation for drought

Preparation can be considered the first step in adjustment: Respondents were asked how they prepared themselves for drought prior to the rainy season. As illustrated in Table 7.1, differences were observed between the peasant farmers and the pastoral nomads. More than one-third of both groups bought grains. The majority of the farmers (63.0%) were involved in agricultural preparation, mostly cleaning lands, and planting dry "*rowal*." In contrast, the majority of the nomads moved onto new pastures and water. It should be mentioned that most of the farmers prepared their land on the belief that the farmer is "*mutawakil*". That means, they prepared their lands regardless of whether the rainy season was thought to be good or bad.

They depend entirely on *Allah* (S.T.).

7.4 Response to the last drought

To examine methods of adjustment to the last drought (1982) by both the peasant farmers and the pastoral nomads, respondents were asked what they did during the last drought. It was found that there was a significant difference between the two groups. The majority of the nomads as compared to only a quarter of the farmers migrated south (Table 7.2).

In referring to the south, pastoral nomads of E. Kordofan, meant those areas around Um Rowaba, Er Rahad and the Nuba mountains (Figure 7.1). The movement south to these areas by the camel owners of the north (The Kababish, The Kawahla and the Hwawir) occurred only very recently (Figure 7.2). Other studies (e.g., Abdalla 1983; Mohamed et al. 1982; Musa 1978; and Qotbi 1982), have pointed out this trend (adjustment). Before the 1960s, the Kababish and the Kawahla tribes used to migrate northwards or north-westerly to Chad (Barbour 1961). Since early 1960s they reversed their migration to a southward or south-westerly direction (e.g., Asad 1964, 1970; Hidore and El Tom 1975), and moved into central Kordofan and Darfur. The field survey in E. Darfur revealed that they tended to move up to Um Hosh and Gabir (Figure 7.3). However, towards late 1970s and the 1980s they had extended their migration nearly 150 km south to the railway (Ad Daen area).

Moving further south was not an easy alternative for the pastoral nomads. First, these areas are the homeland of the *Baggara* "Cattle herders" such as the Hawazma in S. Kordofan and Rezeigat in S. Darfur which might create some conflicts between the two groups. Second, those southern areas have totally different physical environments, in terms of vegetation and soil. The Shanabla animals found the type of vegetation different to that of the Nuba mountains, and many of these animals drifted back north by themselves. Also, moving into those southern zones exposed camels to new types of animal diseases. Qotbi (1982:2) stated that

TABLE 7.1

How do you prepare yourself for drought?

Response	Peasant farmers		Pastoral nomads	
	N	%	N	%
Store grains	12	2.7	4	1.9
Buy grains	152	34.2	82	39.4
Agricultural preparation	280	63.0	0	0.0
Migration	0	0.0	122	58.7
Total	444	100.0	208	100.0

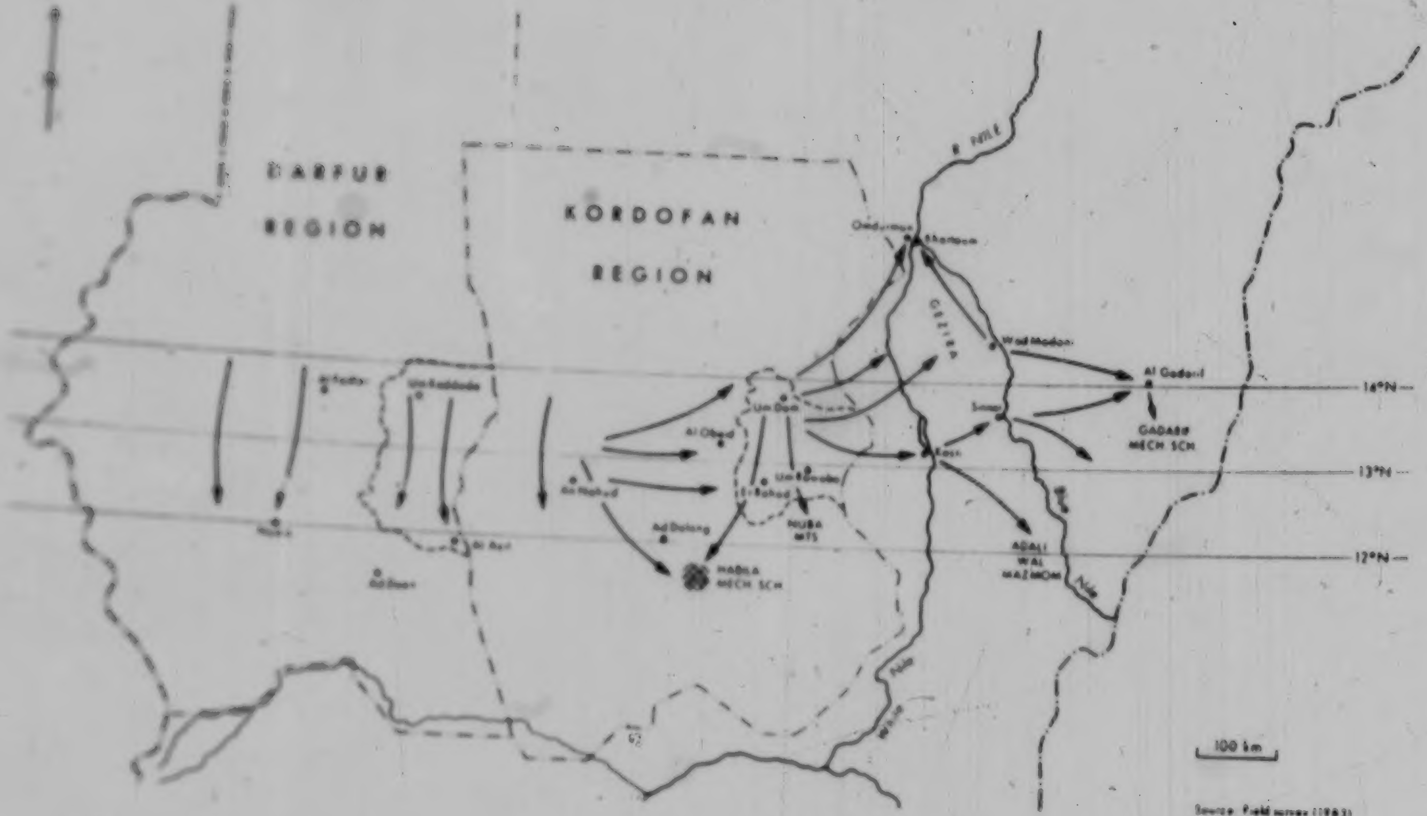
Chi-square = 393.007; d.f. = 3; $p < 0.0000$

TABLE 7.2

What did you do when you knew you were in drought?

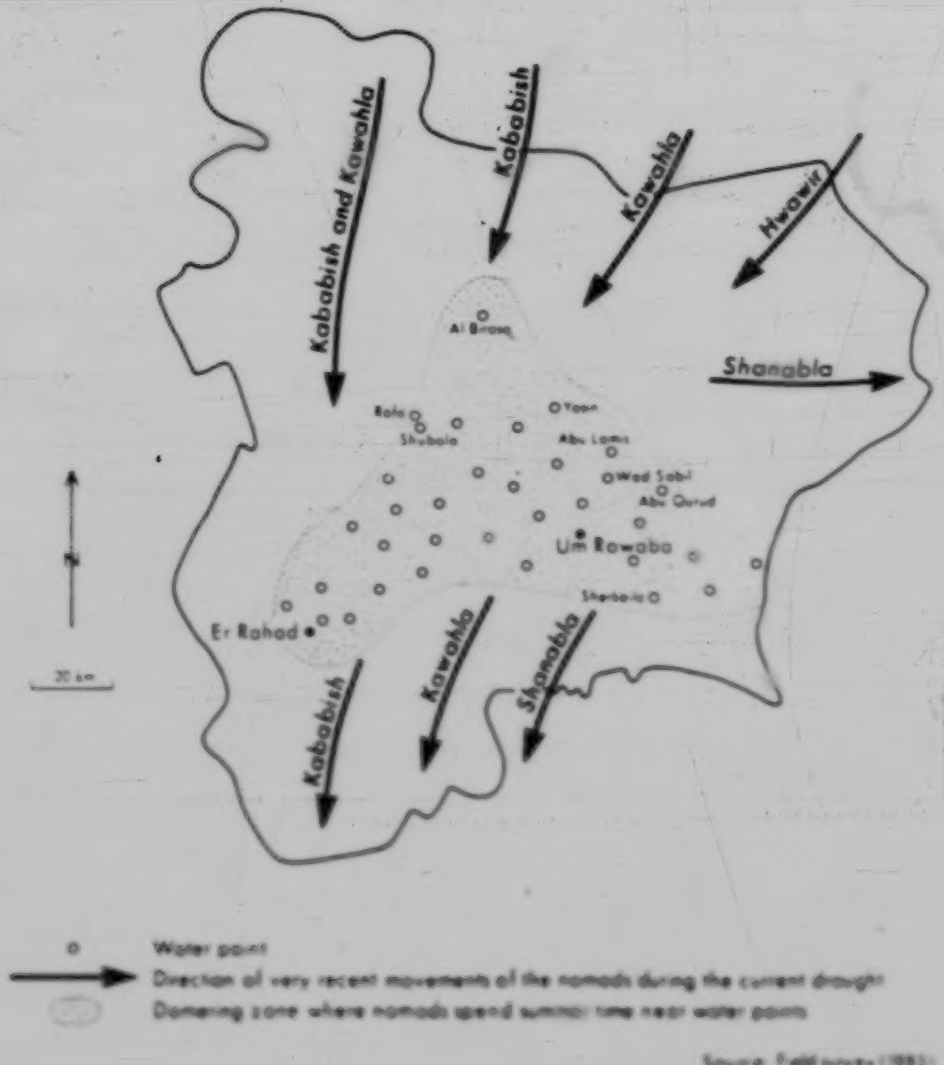
Response	Peasant farmers		Pastoral nomads	
	N	%	N	%
Migrated south	110	24.8	121	58.2
Migrated for job	106	23.9	6	2.9
Stayed at my place	228	51.4	81	38.9
Total	444	100.0	208	100.0

Chi-square = 85.523; d.f. = 2; $p < 0.0000$


DARFUR REGION
KORDOFAN REGION
R NILE
Omdurman
Khartoum
GEZIRA
Wad Medani
Al Gedarif
GADABB MECH SCH
Sinnar
Kosti
ADALI WAL MAZMOM
Nile
Um Dam
Al Obeid
Um Rawaba
Er Rahad
NUBA MTS
Ad Dalang
HABILA MECH SCH
An Nahud
Um Keddada
Nyala
Ed Daein
14°N
13°N
12°N
100 km

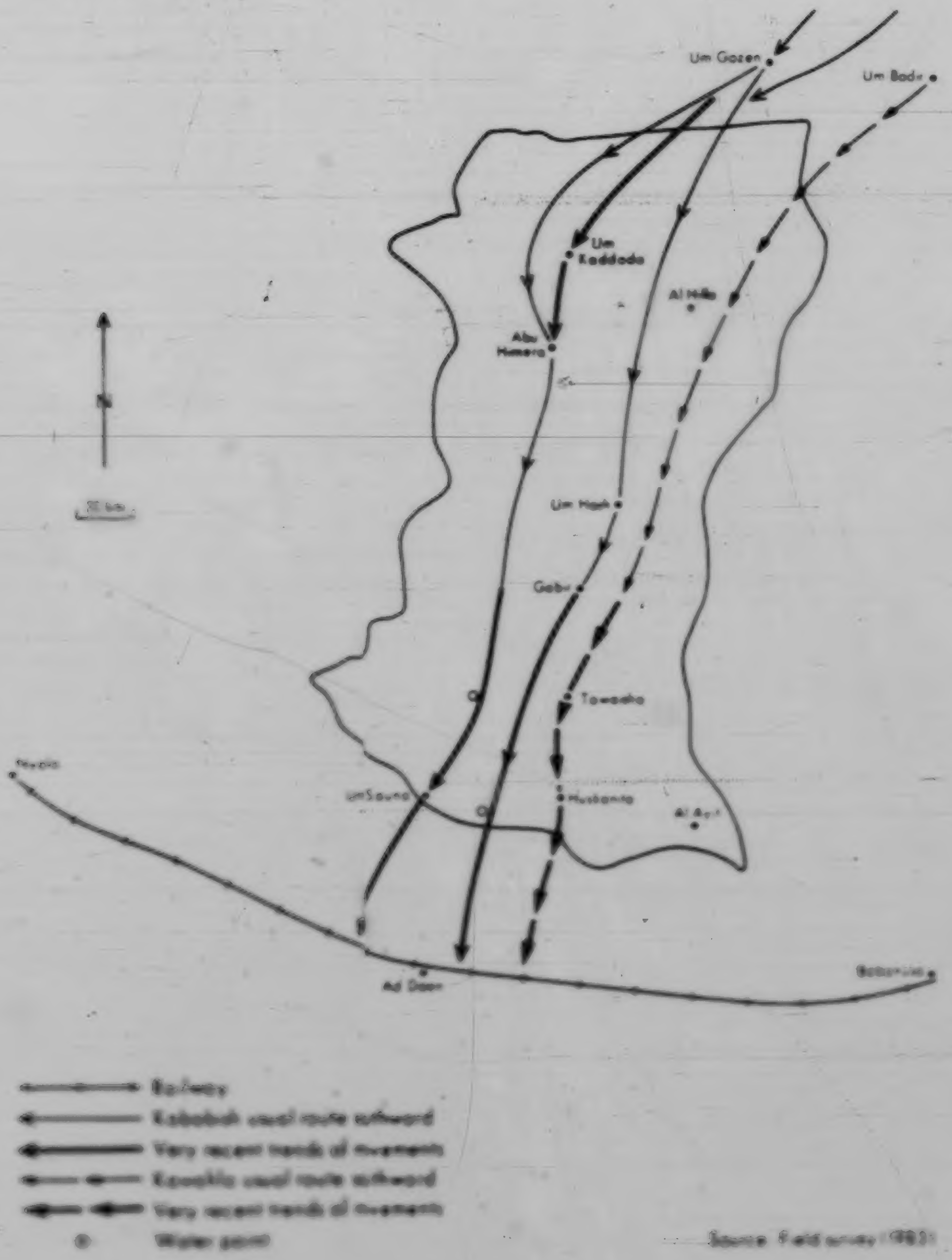
Source: Field survey (1983)

Figure 7.1 Trends of migration of the peasant farmers in the semi-arid and the central parts of the Sudan


Kababish and Kawahla
Kababish
Kawahla
Hwawir
Shanabla
Al Brosq
Rola
Shubala
Yoon
Abu Lamis
Wad Sabil
Abu Qurud
Um Rowaba
Sherbola
Er Rahad
N
20 km
Kababish
Kawahla
Shanabla
Water point
Direction of very recent movements of the nomads during the current drought
Damering zone where nomads spend summer time near water points

Source: Field survey (1983)

Figure 7.2 Zone of the damering places and directions of the recent movements of the nomads in East Kordofan


Um Gozen
Um Badr
Um Kaddada
Al Hilla
Abu Humera
N
50 km
Um Hash
Gabir
Tawasha
UmSauna
Husbanita
Al Ayil
Nyala
Ad Daen
Babanusa
Railway
Kababish usual route sothward
Very recent trends of mvements
Kawahla usual route sothward
Very recent trends of mvements
Water point

Source: Field survey (1983)

Figure 7.3 Routes of usus and very recent movements of the Kababish andhe Kawahla tribes across East Darfur southward

> It was a severe drought last summer (1981) especially in the northern and central districts (Kordofan region), where large numbers of herds died in the arid and the semi-arid areas . . . Due to the lack of grass in this area cattle and camels reached the southern part of the region (Savanna belt). This will expose these animals to flies and some other diseases which were not known in camels before.

The data presented in Table 7.3 reveal the responses of the nomads in relation to the last drought (1982).

The farmers of E. Kordofan migrated to Habila mechanized scheme and the Nuba mountains. They worked there as agricultural labours. In comparison, the farmers of E. Darfur migrated to the south to Al Ayit rural council (Figure 7.1). Reasons given to their migration to the south were that there are mechanized schemes and large size farms in the south (Al Ayit R.C.) where grains (*dura* and *dukhn*) and groundnut are grown, and where work as seasonal agriculture labourers is available. The peasant farmers could harvest the cheap grains from these schemes and send them to their families, as well as earning some cash. They commented on this by saying:

> "The first thing that we do when we go to the south is to secure the annual stock of grains and send it immediately to our families and then work for some time to earn some money."
>
> "For the last five years we depend entirely on Habila's *dura* . . . I go there, work, and bring my family's annual stock of grains."
>
> and
>
> "After I found that the rains were not good, I went Huskanita (Al Ayit R.C.) and worked there and I have just came from there (May 1983)."

In Table 7.4 are presented the adjustments the peasant farmers adopted after they were affected by drought. Interestingly, some 11.7% of the respondents migrated to Al Gadarif or other mechanized or irrigated schemes in the east where they worked as agricultural labourers, (Figure 7.1). These mechanized schemes include Al Gadarif and Adali Wal Marmoh, and the irrigated schemes, the Gezira scheme, the White Nile Pump Schemes along the White Nile north Kosti, and Er Rahad Scheme (E. Wad Medani). About 11.4% of the farmers went to

TABLE 7.3

What did you do after you knew you were in a drought?

Response	N	%
Migrated to areas of rich pastures & water supply	121	58.2
Sold animals and bought grains to feed the rest	72	34.6
Stayed near a water point & brought or bought grass	8	3.8
Worked as an agricultural labourer	4	1.9
Migrated to find a job in town	2	1.0
Worked as a shepherd	1	0.5
Total	208	100.0

TABLE 7.9

Actions that have been undertaken by peasant farmers after they decided that they were in drought

Response	N	%
Went to the southern part of the area	110	24.8
Stopped farming and worked in other jobs in the village or nearby villages	91	20.5
Stayed at the village	67	15.1
Went to town to seek work	46	10.4
Stayed at the village and worked in tapping Hashab trees	38	8.6
Worked in business	32	7.2
Went to Gedaref mech. schemes or other sources such jobs for work	31	7.0
Went to the Nile and other irrigated schemes for work	21	4.7
Missing cases	8	1.8
Total	444	100.0

town to seek work. They either migrated to the towns of Kordofan and Darfur regions, or to the big cities along the Nile, mainly Khartoum. Others (8.6%) stayed at their villages, and either took jobs like janitor, street cleaner, tapping *Hashab* trees, or receiving money from sons. Some sold animals or otherwise worked in business.

In summary, migration is the common response to drought by the majority of the nomads, and by almost half of the farmers, in central Sudan. The trend of migration tended to be to the south (the Savanna zone) or eastward to the irrigation schemes along the Nile, or to mechanized schemes and big cities like Khartoum and Wad Madani. Some respondents from both groups stayed at home, either taking jobs or working in business, or selling animals and buying grain.

7.5 Perception of adjustment

Both farmers and nomads were asked what they thought could be done to overcome or lessen the effect of drought. The overwhelming majority of the farmers (96.4%) compared with more than half of the nomads (56.3%) stated that nothing could be done except praying to ***Allah (S.T.)*** to give them rains. Praying to ***Allah (S.T.)*** was performed either individually or collectively. In most cases, all of the villagers would go beyond the village boundary and pray, especially utilizing the prayers called "Rain Prayers". The people impress on their children the belief that ***Allah (S.T.)*** may accept their prayers and bring them rains. In some cases, people asked a religious man called a "***Faki***" to pray on behalf of them in order that ***Allah (S.T.)*** may bring them rain. They would give the "***Faki***" money in return.

Praying for ***Allah (S.T.)*** is not far from the belief mentioned by many respondents, that drought is a kind of punishment from ***Allah*** (S.T.) for their bad deeds. It has been noticed that the peasant farmers more than the pastoral nomads believed in praying. This result may indicate that the peasant farmers are more religious, than the pastoral nomads. Related to prayer is the presenting of sacrifices or "*Karama*." The respondents follow the same procedure as in praying. They go outside their villages, slaughtering a calf or lambs, or boiling grain, "*Balila.*" *Karama* is the most common type of sacrifice. In some other cases, people used both prayer and *Karama* the same time. The differences between them is that praying is a man's job, whereas making *Karama* and *Balila* is undertaken by women. These findings agree with some other studies, such as Berry et al. (1971), Dupree and Roder (1974), Heijnen and Kates (1974), Ibrahim (1981), and Wisner (1976).

Another pattern of adjustment to drought is migration. Migration was mentioned by three-quarters of the nomads compared with 15.8% of the farmers. These figures are different from those cited in Tables 7.1 and 7.2. This may be because farmers are influenced by their religious beliefs and therefore praying and presenting sacrifices are perceived as first options. In comparison, migration is part of the cognitive make-up of nomads, therefore, it was perceived as the most important adjustment. Buying of grains was mentioned by 19.2% of the nomads and only 2.0% of the farmers. Buying, storing or transporting grass from a distance was mentioned only by the nomads.

Analysis of resource users' perception of adjustment revealed that such responses have religious (praying and offering sacrifices), social (migration), economic (buying of grain), and environmental (making grass available) implications. These are very short-term adjustments which could be carried out at the very beginning of the hazard occurrence (i.e., drought).

7.6 Specific adjustments

A number of specific adjustments were mentioned by each group. To the farmers these are exemplified by on-farm adjustments, while to the nomads it is confined to migration, selling of animals and buying of grain.

7.6.1 The Peasant farmers' on-farm adjustments

On-farm adjustments include crops grown, changes in farm operations, timing and mixing of crops, replanting, intercropping, seeds dressing, farm fragmentation, changing of farm location, cleaning of lands, weeding, crop innovation, and the construction of wind shelters. Respondents were asked about the crops they were growing. The peasant farmers grow a variety of crops. Almost all respondents cultivated *dukhn* (millet), while above eighty-eight percent cultivated sesame. The majority (61%) grew water melon, and half of the respondents cultivated *zenari* or *marag* (sorghum). Other crops which are grown include *waka* (okra), groundnuts, *Karkadi* (*Hibiscus sabdariffa*) and *Iobia* (*Dolichos lablab*). Not all of these crops are cultivated by each peasant farmer in the same year. The average farmer usually cultivates between two to four of these crops.

To examine the factors that influence the choices and the number of crops that are cultivated by the individuals, the respondents were asked to point out the reasons as to why they chose to cultivate all or part of these crops. Almost half of the peasant farmers (43%) cultivated those crops because those were the ones they perceived as growing successfully in their environment. This has been attributed to the amount of rainfall. One comment was that

> "Rains are just enough to grow these crops."

In contrast, from these crops only groundnuts were grown in the southern parts of the study area. In the northern parts the farmers had tried to cultivate groundnuts, but this had not been a success:

> "We tried to grow groundnuts but because it needs more rains, it didn't grow well here".

Thirty percent answered that those were the crops that their fathers had grown. About 18.0% answered those were the ones acceptable in this type of soil, which is the sandy soil of the *Goz* land. The farmers frequently mentioned their liking for the Goz soil:

> "We are *Gawaza* (Goz inhabitants). We do not cultivate more than these crops."
>
> "*Al Goz Hinayin* (the Goz is kind, and we like it)."

Such comments indicate the strong emotional and psychological ties between man and land, and how this strong relationship may affect man's behaviour. The latter comment indicates that the farmers of the study area have a positive attitude towards the type of soil that provides them with a livelihood.

Some few percent of the respondents (the elderly and poor peasant farmers) mentioned physical and financial inabilities of the peasant farmers as reasons for cultivating certain crops. They found it very difficult to cultivate many crops or large plots:

> "*Al Ziraa hara* (Cultivation is not an easy job). I am getting old, and I have no energy for it. I cultivate what is enough for me and for my family."
>
> "I work by myself, my sons are not here to help me, and I have no money to hire labourers . . . and as you see I am an old man and cultivation needs younger people."
>
> and
>
> "The people who were able, they hired labourers to cultivate for them more crops and more area. I am only a poor man. I cannot cultivate more than I can afford. I myself, I go and work for others, in order to be able to earn some money."

A small percentage of the peasant farmers (3.2%) responded to the lack of rains at the beginning of the season by cultivating one or two crops only. When they saw the *dukhn* wither and die, they did not try to weed it, or attempted to cultivate other crops, but migrated instead. Some of the spontaneous comments were:

> "I wouldn't throw my seeds to the birds and rodents, whereas what I have cultivated (*dukhn*) died already."
>
> "The beginning of *Al Khareef* (rainy season) was not good. I thought it would be a better idea not to waste my seeds and keep it for next year."

The field survey revealed that there were some cultural factors which influenced the choice of growing certain crops in favour of other crops. For example, there was a certain variety of millet called "*Abu Sofa*" or "*Abu Shaara*" (Sirara Composit - 2). This millet is a quick maturing crop which was distributed by the authorities in E. Darfur in 1962 to replace *dimbi* variety, because *dimbi* is more susceptible to damage by birds, whereas *Abu sofa* is a bird tolerant variety (because of its bristles, birds cannot attack it). It reaches maturity at about the same time as the *dimbi*. A story told by one farmer at one of the mosques, was that this successful variety was unfortunately rejected by all peasant farmers in E. Darfur because of religious beliefs. Now some of the seeds of this variety grow wildly in the fields with other varieties. According to a local tradition which has its basis in religious beliefs, the crops which are cultivated by the peasant farmers are for *Al Ghashi Wa Al Mashi*. This means that these crops not only belong to the peasant farmers, but to other creatures in the earth, such as insects, birds, animals, and human beings. This is important because offering crops to the birds, animals and human beings may please *Allah* (S.T.) who will bless the production of crops. However, cultivating *dukhn Abu Sofa* would prevent birds from having their share.

A story explains how a peasant farmer cultivated his farm with *dukhn Abu Sofa* and the birds could not enter his farm. Next year he did the same, and birds could not harm his crop, but this time all the ears were bent down and looked like birds. He took a sample of these ears and showed that to the people at the mosque. The people advised him to stop cultivating *dukhn Abu Sofa*. This had been interpreted as an anger and a warning from *Allah* (S.T.). Ever since that time no one has cultivated this variety or even likes to speak about it.

Another factor which affects choice of plants is preference. For example, people like and prefer the *Shuroba* to the *dimbi* variety of millet because it tastes and looks nice. Farmers also prefer some introduced crops instead of the ones they used to cultivate (Figure 7.4).

In order to determine if the farmers had adjusted to the drought by changing their mode of farming, the people were asked whether they had changed the nature of their farm operation. The majority (68%) answered "No." Of the percentage (32%) who made changes, three-quarters had introduced "*remal*," which means planting dry before the rainy season. The area covered by *remal* varies between 25.0% and 75.0% of the total area of farms. *Remal* is carried out only for *dukhn*, groundnut and sesame. The reasons why the farmers practised *remal* were varied, first, because of the drought, the peasant farmers would like to maximize

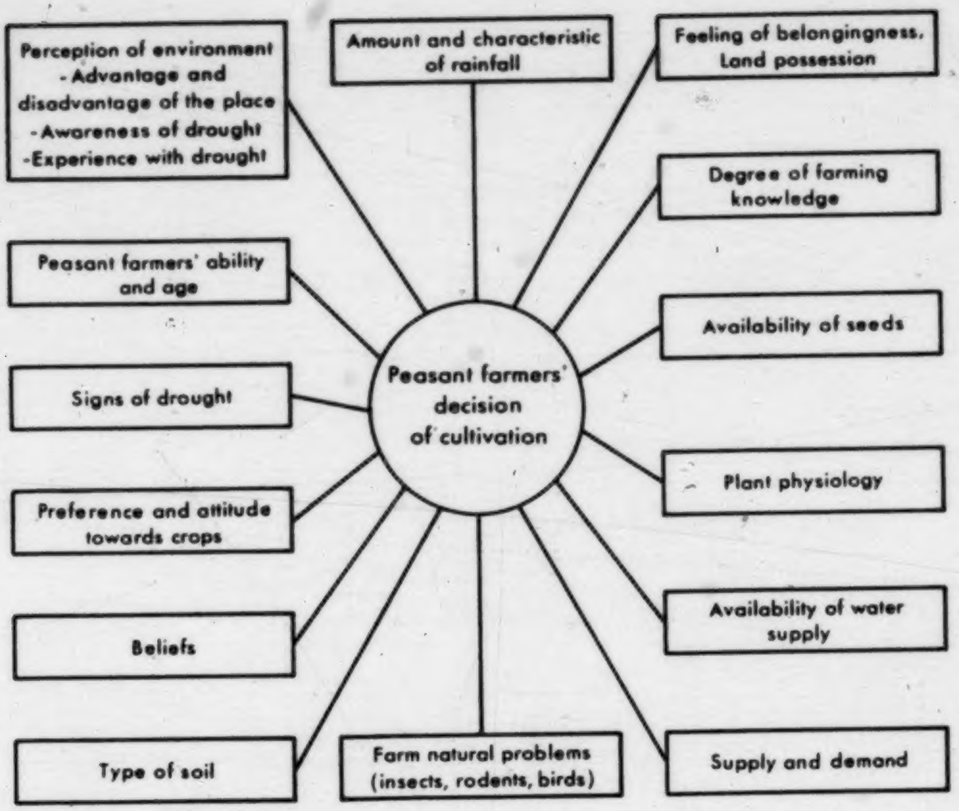

Perception of environment
- Advantage and disadvantage of the place
- Awareness of drought
- Experience with drought
Amount and characteristic of rainfall
Feeling of belongingness, Land possession
Degree of farming knowledge
Peasant farmers' ability and age
Availability of seeds
Peasant farmers' decision of cultivation
Signs of drought
Plant physiology
Preference and attitude towards crops
Availability of water supply
Beliefs
Type of soil
Farm natural problems (insects, rodents, birds)
Supply and demand

Figure 7.4 The main factors affecting the decision of cultivation by the peasant farmers

moisture utilization by cultivating part of the farm in May and June. In this case if rains came during that time the production of *remal* would give twice as much as that cultivated in July or more. Some of their comments were:

> "In old times *Al Khareef* (rainy season) was very good and "complete," but these years it became very short. Therefore, by practising *remal* we would like to increase the season."
>
> "*Wad Al Badri Sameen* (If rains came good in May and June) we would expect a bumper crop."
>
> "We are competing with the rainy season because it tended to be short in recent years."

Second, some of the farmers practise "*remal*" as they wanted to sow most of their farms before the rainy season, because later during the rainy season they would be working for other farmers. Third, most of the farmers of Al Ayit rural council in E. Darfar are market-oriented and cultivate large size farms. They are always in need of hired labourers which are impossible to obtain at the beginning of the rainy season. Therefore, they can only cultivate large areas through "*remal*" when labourers are available. The problem of labour shortages has increased in recent years in this area. This is because in the past the southern labourers (Southern Sudan) migrated northward to work in Al Ayit R.C, but now owing to some tribal conflicts, they are not allowed to come. Fourth, some practise "*remal*" to escape the period when birds are abundant at the end of September.

In contrast, almost a quarter of the respondents who changed their farm operation, had stopped "*remal*." The reasons given for this also were; First, in the recent years of the current drought, in most cases the rains of May and June were not enough to grow the crops which are cultivated through *remal*. Therefore, the seeds grew above the surface of the land, and because of the lack of rain and the high temperatures, they withered and died. For some farmers this process was repeated a number of times. Therefore, instead of losing their seeds, they decided to stop "*remal*." Second, because of the years of drought, problems caused by rodents, birds and insects have increased. As soon as the seeds were buried in the land birds, insects and rodents dug them up and ate them. Here are some of the comments by local farmers:

> "We became tired of ***Al Babrais*** (Field rats and other unknown rodents). You can't fight them because they attack farms at night, and the government didn't help us in fighting them."
>
> "In recent years ***Al Bahit*** (Field rats and unknown rodents) have increased, and seeds were becoming very expensive. Therefore, I can't afford losing my seeds. I will wait until the "***Nadaya***" (Wetness-rainfall) and then I will cultivate."

For the majority of farmers, the changes that were made were confined to practising, or not practising "***remal***". The decision to choose either of these alternative adjustments was undertaken by the peasant farmer based on his own value judgement and circumstances.

Time of planting was calculated very carefully by the peasant farmers, and it is governed by (1) the time and the availability of rainfall at both the beginning and the end of the season, and (2) the potentially adverse effect of wind, insects and bird hazards towards the end of the season. The field survey in Al Ayit R.C. namely Um Hosh, Gabir and Karoya (the marginal area between the semi-arid and the savanna) revealed that the peasant farmers were cultivating ***Shuroba*** (late maturing variety of millet). It needs 120 days to reach maturity. The farmers felt that it tended to yield less than it used to, therefore, they thought of subsituting this variety with ***dimbi***, which is a quick maturing variety that needs about 90 days to reach maturity. It is the dominant variety of millet in the north "Um Kaddada R.C.".

Some farmers tried the quick maturing variety "***dimbi***", but it did not yield as much as was expected. This is not because of drought but because the time in which it ripened coincided with the arrival of birds that attacked the crops. Therefore, farmers had two choices, either to fight these birds, or continue cultivating their old late-maturing crop that escaped the periods of bird attack. They chose the latter. The strategy which has been followed in Al Ayit R.C. in order to escape the period of birds, insects and wind hazards (November and December) is that millet must be harvested at the beginning of November and again in January "***Shokaib***". This is only possible through cultivating the late-maturing crop "***Shuroba***"

In W. Kordofan "Wad Banda area," peasant farmers cultivate *zenari* at the beginning of August. This is because *zenari* grows very high and it can be broken easily by wind in the time of *darat* (end of the season Oct. and Nov.). Therefore, it is cultivated late in August so that it will not be too high in October and November, and thus will not be damaged by the wind.

In contrast, in the northern part of E. Kordofan some of the farmers start cultivating in May and June to escape the period of birds at the end of September. In the southern parts of this region, if the farmers found that the rains were not good in May and June, they would not cultivate ***dukhn***. This choice was meant to avoid attack of the crop by birds at the end of September. Also the lack of rain (drought) would mean that ***dukhn*** would not reach maturity by the end of September.

Some differences were observed between E. Kordofan and E. Darfur. The peasant farmers of E. Kordofan placed more emphasis upon the availability of rainfall and less on other problems such as insects, birds and wind. This was evident from the fact that in mid-August (1983) some farmers were cultivating their farms for the first time. Alternatively, the farmers of E. Darfur (mainly Al Ayit R.C.) appeared to care more about the problems of wind, birds and insects. The E. Darfur farmers are not unduly concerned about rain, since they have enough rain to enable them to harvest for a second time (*Shokaib*) in December and January. In comparison, the farmers of E. Kordofan harvest only once, if at all.

Mixing of crops, intercropping and planting were treated together in most cases, since it is very difficult to separate these farm adjustments from each other. These adjustments, however, took different forms in the study area.

Mixing of 3-4 crops in one hole. Three or four crops are mixed together and cultivated in one hole. As can be seen from Table 7.5, the most common mixture in E. Kordofan combines *zenari* (sorghum) with sesame, together with *lobia* "*Dolichos lablab*" and water melon, or water melon by itself or *Karkadi* (*Hibiscus sabdariffa*).

TABLE 7.5

Alternatives of mixing of crops, intercropping and replanting

Region	Crop mixture			Intercropping & replanting
E. Kordofan	1. Zenari & Sesame	- Lobia - Watermelon	Either or	1. The same mixture
	2. Zenari & Sesame	or - Watermelon	or	2. Sesame & Watermelon
	3. Zenari & Sesame	or - Karkadi		3. Sesame only
	2. Zenari	- Watermelon - Lobia - Karkadi		The same mixture
	3. Dukhn	- grows by itself (hot)	Either or	1. Dukhn 2. Late-maturing sesame (Dari)
E. Darfur 1. Um Kaddada R.C.	1. Dukhn & Marag	- Sesame - Watermelon	 or or or	1. Marag only 2. Dukhn & Marag 3. Marag & Watermelon 4. Marag, Sesame and Watermelon
	2. Sesame & Watermelon			The same mixture
	3. Groundnut	- Watermelon or - Lobia		The same mixture
2. Al Ayit R.C.	1. Dukhn		 or or or	1. Lobia after replanting dukhn 4 times 2. Marag 3. Sesame 4. Marag & Lobia
	2. Groundnuts		Either or	1. Watermelon 2. Lobia

This mixture is intercropped or replanted by the same mixture, or with sesame and water melon, or with sesame only. Differences between the peasant farmers were expected. The decision of mixing many crops together was governed mostly by the availability of crops.

"I will mix or plant whatever number of crops available to me."

Another form of mixture was by mixing *zenari* with watermelon, *lobia* and *Karkadi*. This mixture was usually intercropped with the same crops.

The reasons behind these different types of mixture are as follows: 1. These crops have different heights which do not affect the growth of each other. 2. The crops beneath *zenari* (*lobia*, water melon and *karkadi*) will get the benefit of having the rain water which is caught by *zenari* leafs. Those leafs will act as a "catchment area," consequently, rain water will be channeled down directly to the roots of other crops through *zenari* stem(s). In this way the roots of the mixed crops will have the maximum benefit of moisture as long as the water is confined in the root zone. Consequently, the saturation zone will be around the plants' stems and decrease from the centre (stems of the mixed plants). This area of concentrated moisture will retain its moisture longer if compared with some parts away from the centre, as it is shaded by *zenari* leafs and it is not exposed directly to the rays of the sun. 3. Water requirements for each plant are different, and by mixing three or four crops, they can depend on each other in terms of moisture and at least one of them is expected to reach maturity and yield. 4. The people believe that "these crops accept growing together." 5. During growing, the wind separates the crops from each other and allow each space to grow. 6. Crops do not ripen at the same time the peasant farmers have the chance to harvest each of them with the least labour requirements.

In contrast, ***dukhn*** is cultivated as a separate stand, and replanted or intercropped by ***dukhn*** only. In a few cases it was replanted or intercropped by late-maturing sesame (*Dari* or *Tageel*). The reason given by the peasant farmers was ***dukhn Har*** (***dukhn*** is hot); it does not accept any other crop to grow with it.

Some peasant farmers in E. Kordofan were practising intercropping to see which of the mixed crops was growing successfully near their farms. Consequently, they intercropped their farms with that type of crop.

In Um Kaddada R.C. in E. Darfur crop mixing takes a different approach with regard to the mixing of ***dukhn*** and other crops. ***Dukhn*** is always mixed with ***marag*** (sorghum) , seasame and watermelon. This mixture is intercropped either by ***marag*** only or ***dukhn***, and ***marag*** or ***marag*** and water melon or ***marag***, sesame and water melon. The main crop among those forms of intercropping is ***marag***. The reason that ***marag*** is the common factor in all these forms of intercropping is that ***marag's*** water requirement is less than ***dukhn***. Therefore, to avoid shortage of rain at the end of the season, the peasant farmers replant ***marag*** instead of ***dukhn***. Another formula of mixing crops in Um Kaddada R.C. is that of mixing sesame and water melon and intercropping with the same mixture (sesame and water melon). Groundnuts are mixed either with water melon or ***lobia***. In fact, both ***lobia*** and water melon can grow successfully with groundnuts. The reason they are not mixed with groundnuts in the same plot is that, farmers want to save as much space as possible for the groundnuts, since it is the main cash crop.

In Al Ayit R.C. the pattern of mixing crops is similar to E. Kordofan with regard to ***dukhn***. ***Dukhn*** is cultivated in a separate stand by itself. It will be replanted four times before being intercropped with ***lobia***. The reason for it being intercropped a fifth time with ***lobia*** is the shortage of rains towards the end of the season since ***lobia*** does not need much water. In some other cases they were either intercropped with ***marag*** or sesame, or ***marag*** and ***lobia***. This is the same reason why ***dukhn*** is cultivated in a separate stand in E. Kordofan, and was pointed out by the farmers of Al Ayit R.C. when they said the ***dukhn*** is "hot". Groundnuts are first cultivated in a separate stand, then later intercropped with ***lobia*** or watermelon.

The reasons given by the peasant farmers of E. Darfur for the mixing, intercropping and replanting of crops were that (1) moisture requirement are different for each crop, and by mixing these crops the farmer would ensure that one or two of these crops will reach maturity,

(2) *dukhn* in most cases is intercropped with *marag* because the rainy season is becoming short and *marag* requires less water than *dukhn*, and (3) these adjustments were undertaken to avoid the attack of insects.

There is a marked difference between E. Kordofan and E. Darfur in general and Um Kaddada R.C. in particular pertaining to mixing of *dukhn* with other crops. The farmers of E. Kordofan do not mix *dukhn* with other crops because they believe that *dukhn* is "hot." The farmers of E. Darfur do exactly the opposite. They mix *dukhn* successfully with other crops. As the soils and other factors in the two areas are the same this illustrates an interesting example of how beliefs influence adjustments and farming practices.

The mixing of crops, intercropping and replanting in rows is carried out largely in E. Darfur and W. Kordofan (Ibrahim 1981), and to a lesser degree in E. Kordofan. In E. Darfur and W. Kordofan, mixing, intercropping and replanting takes different forms. First, the peasant farmers cultivate two rows, one of *dukhn* and the other of *marag* alternatively. Second, in the *dukhn* row, if the seeds of any particular hole do not germinate, they will be replaced by *marag*, or sesame. In E. Kordofan the row of the mixed crops which do not germinate will be replanted with one of the methods illustrated in Table 7.5. Third, the peasant farmers sprinkle some seeds between rows. This method is widely used in E. Kordofan. Farmers either sprinkle water melon among *zenari* and sesame mixture (This method is known locally as "*Awam*") or *karkadi* among the *zenari* - sesame mixture. Only *waka* (okra) is excluded from this mixture, because it is cultivated by women in a small part of the field. Finally, in cases where peasant farmers cultivated three varieties of sesame, they are cultivated separately. This is because they do not reach maturity at the same time.

In conclusion, the above discussed on-farm adjustments (time of planting, mixing of crops, intercropping and replanting) are strategies that have been developed by the people of the semi-arid areas of the Sudan before the current drought (Burnett 1948), in order to suit the rainfall variability of that area. These strategies have been reconceptualized as adjustments to suit the very short rainy season, and to reduce the risk of drought hazard. The strategies aim at maximizing moisture utilization and reducing moisture waste. In addition, some have been undertaken to avoid other hazards like birds, insects, wind, and rodents.

These findings contrast with those of Zuckerman (1979), who explained the reasons for intercropping and mixing of crops as a means of saving time, reducing farm labour requirements, providing stems from some crops for others to climb, and a means to save land. They also contrast with the finding by Igbozurik (1971), that mixing of crops and intercropping provide a dense network of plants to hold down the penetration of weeds. However, the findings presented here agree with Igbozurik's findings that they provide a means of retarding the spread of plant-specific pests. The findings also contrast with the findings of King (1968) who noted that intercropping is practised by the Yorubas as a means of conserving human energy, and with Geertz (1963), who mentioned that the shade of taller plants can retard erosion by reducing the impact of rainfall on the ground. These results agree with Jodha (1980), as far as risk minimisation and fuller exploitation of environment through inter-planting crops of different maturity periods are concerned. However, contrary to his finding that seed mixing was the least popular method compared with row or strip alternation, it was found that among all methods seed mixing is the most popular method in central Sudan.

Seed dressing and treatment are important parts of the on-farm adjustment. The peasant farmers have tried different methods to prevent their seeds, once buried in the ground, from being attacked by rodents and birds, as well as trying to protect the seeds from germination if rain is inadequate. In E. Kordofan, the peasant farmers dress their seeds with pesticides, mainly DDT, before burying them during the "*remal*" period. By doing so, they are trying to protect their seeds from the attack of *Al Bahit*, *Al Babrais* (Field rats and unknown rodents), as well as birds. A technique used by the peasant farmers of E. Darfur for protecting their seeds from inadequate rain in the pre-season period while they are carrying out "*remal*" is to dress their seeds (*dukhn* and groundnuts) with chemical fertilizers (*samad*) before burying them. The outer layer of the fertilizer will protect the seeds. The seeds will not germinate until adequate rain dissolves the fertilizer and reaches the seeds. These seeds not only will be protected from meager rainfall but also from insects, rodents and birds.

Another seed dressing relates to religious and traditional beliefs. A farmer may ask a religious man (*Faki*) to give him some "*Bukhrat*" or *Mihaya* (Black or grey water with which some written verses from holy Quran were washed). The peasant farmer cleans his seeds, mainly water melon, with some of that *Mihaya* before he buries them.

Another form of on-farm adjustments is farm fragmentation, or the changing of location and weeding. The prime reason for practising this is to cope with the scattered nature of rainfall (Hammer 1972). Most of the farmers divide their farms into small plots located in different places around the village. By doing so, they aim at maximizing moisture utilization and spreading the risk:

> "I am trying to trap the rains in all four directions of the village. It has no chance to escape me this time."
>
> "Lucky person, he cultivated in the direction where rains came in abundance, while the other parts of the village have got nothing."

Farm fragmentation and changing farm locations was carried out in the past because of the problem of getting one piece of land for a farm. Changing location is part of the inherited system of changing land after some years, because the land loses its fertility. Today, changing location is carried out mainly as an adjustment to cope with the new environment which has been created by drought itself. In order to cope with the short and unreliable rainy season, the farmers also have introduced some quick maturing crops like *Hirahri* (sesame variety). *Hirahri* does not yield well or at all on an old farm, which has been cultivated for four to six years. Therefore, cultivation of such popular varieties necessitates the changing of farm location. In contrast, the late-maturing variety of sesame (*Tageel, Baladi* or *Dari*) grow best on old farms or "*Saraya*".

Weeding also is meant to maximize moisture utilization. In recent years after weeding, farmers tended to leave the weeded grass on the farm; first, to reduce moisture waste and second, to protect the newly grown plant from being buried by wind erosion.

7.6.1.1 Crop innovation

Crop innovation is another form of farm adjustment to drought hazard. Respondents were asked whether they had introduced new crops in recent years (years of drought). One-quarter of the peasant farmers answered "Yes." The data presented in Table 7.6 suggest that there was a significant difference between the farmers of E. Kordofan and E. Darfur. There were three times as many who introduced new crops in E. Kordofan as in E. Darfur.

The peasant farmers who had introduced new crops were asked to point out those crops and some 16 varieties of crops were mentioned. The vast majority of the respondents introduced *hirahri* (Table 7.7). The overwhelming majority of the mentioned crops were sesame varieties (9); four were sorghum varieties; two were millet varieties, and one was a groundnut variety. This, however, poses the important question as to which of these are quick-maturing varieties. In order to answer this question, there needs to be a standard measurement for the quick maturing variety. Among sesame varieties, ***hirahri***, from its meaning "the very fast growing crop," is mentioned most frequently by all farmers as a quick maturing crop. It reaches maturity between 60 and 70 days. How fast it reaches that point depends on the availability of rains. On the average it needs 65 days before it is ready for harvesting. In contrast, the late-maturing variety (***Tageel, Baladi*** or ***Dari***) takes 120 days, almost double the period needed by ***hirahri*** to reach maturity. Thus, ***Swduna***, ***Wad Almurdi*** and ***Wad Al Awad*** sesame varieties may be classified as quick-maturing varieties, whereas ***Bulwa, Wad Rabih, Wad Azrag, Gabarok*** and ***Abu Sundoog*** may be considered as in between the two extremes, "quick and late-maturing."

Huggana and ***Dagoga*** are quick-maturing varieties of sorghum. Similar to the late-maturing variety of sesame, the late-maturing variety of sorghum takes 120 days to reach maturity. According to this measurement, ***Azzol Mino*** and ***Wad Um Gasari*** may be classified as in between the quick and late-maturing. Both millet varieties ***Dimbi*** and ***Abu Sofa*** are quick maturing crops. Groundnut also is a quick maturing variety.

TABLE 7.6

Have You Introduced a New Crop in Recent Years?

Response	E. Kordofan N	%	E. Darfur N	%	Total N	%
Yes	91	34.2	21	11.8	112	25.2
No	175	65.8	157	88.2	332	74.8
total	266	100.0	178	100.0	444	100.0

Chi-square = 27.224; d.f. = 1; $p < 0.0000$

TABLE 7.7

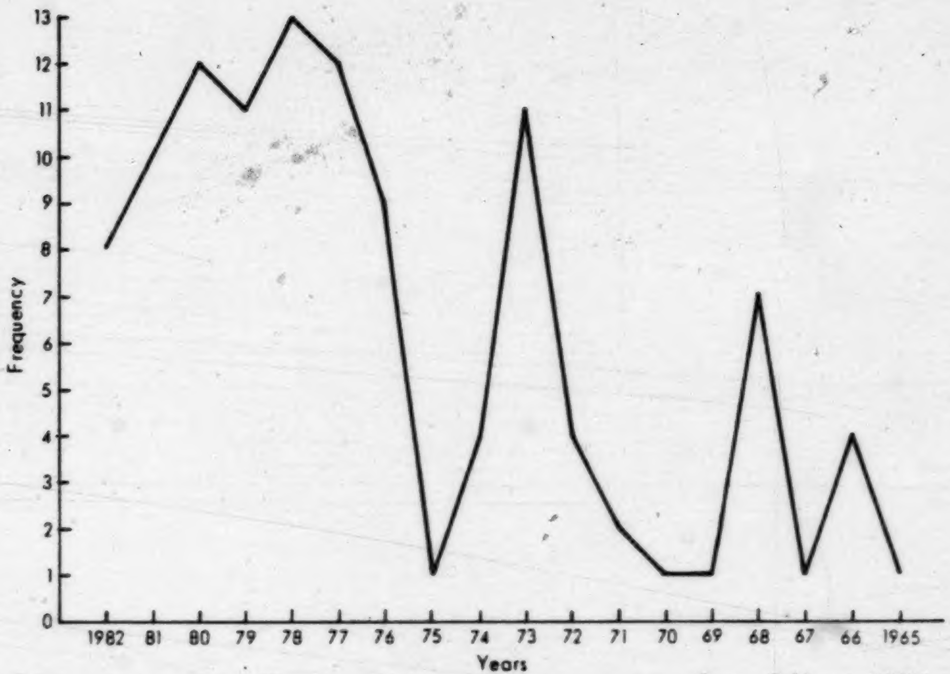
Crops that have been introduced in recent years

CROP Sudanese name	English family name	N	% of sample	% of responses to the question	Days to reach maturity
Hirahri	Sesame	70	15.8	62.5	60-70
Swduna	Sesame	9	2.0	8.0	75
Bulwa	Sesame	7	1.6	6.2	85
Dimbi (Dukhn)	Millet	6	1.4	5.3	90
Wad Rabih	Sesame	4	0.9	3.6	80-85
Wad Azrag	Sesame	3	0.7	2.7	90
Wad Almurdi	Sesame	2	0.5	1.8	75
Gabarok	Sesame	2	0.5	1.8	90
Foul	Groundnuts	2	0.5	1.8	100
Huggana (Nagad)	Sorghum (Q.M.)	1	0.2	0.9	60
Azzol Mino	Sorghum	1	0.2	0.9	90
Wad Um Gasari	Sorghum	1	0.2	0.9	90
Dagoga (Nagad)	Sorghum (Q.M.)	1	0.2	0.9	60
Wad AlAwad	Sesame	1	0.2	0.9	75
Abu Sundoog	Sesame	1	0.2	0.9	80
Abu Sofa (Dukhn)	Millet	1	0.2	0.9	75
Total		112	25.2	100.0	

Farmers were asked why they introduced these crops. The overwhelming majority (96.4%) introduced them because they were quick maturing crops. According to the above discussion, only 8 (50%) of all crops can be classified as quick-maturing in a real sense, while none of them are late-maturing crops. Therefore, it is reasonable to suggest that the peasant farmers perceive any crop which does not take four months (late-maturing) as a quick maturing crop.

Those who introduced new crops were asked when they started cultivating these crops. The data presented in Figure 7.5 indicate that the years in which the crops were introduced go back as far as 1965. The graph, however, shows peaks in 1966, 1968, 1973, 1978 and 1980. A possible explanation for this is that these years coincided with severe years of drought. Meteorologically four out of five of the above mentioned years (1966, 1968, 1973 and 1980) were drought years(Hulme 1984:283). Moreover, the years from 1976 to 1981 were the years in which most farmers had introduced new crops. Again, those years were the years in which drought increased steadily (e.g., Al Saim 1984; Hulme 1984; Nicholson 1983). Apparently, there is a close relationship between intensity of drought and introduction of new crops.

In order to obtain some information on the dissemination of ideas among the farmers, those who adopted new crops were asked to identify who brought the new crop(s) to their area. It was found that the majority (58%) of the respondents had no idea as to who introduced the crops. Although the peasant farmers did not know exactly who brought them, they were very much aware of the fact that some of the newly introduced crops were named after the person who first introduced them to the study area. Five of the new varieties of sesame were named after the persons who brought them. These include ***Wad Rabih*, *Wad Azrag*, *Wad Almurdi*, *Wad Um Gasari*** and ***Wad Al Awad***. Almost one-quarter replied that either they brought it by themselves or by one of their families or friends. Above seventeen percent responded that they bought the seed from a merchant in the village.



Source: Field survey (1983)

Figure 7.5 Years of introducing new crop varieties by the peasant farmers

The way in which the farmers conserve these new crops reflects a high degree of drought awareness, as well as a knowledge of other hazards like birds, rodents and insects. As soon as a new crop is introduced by a farmer in the village, he gives some of the seeds to his neighbour in order that he might cultivate it on his farm. Both farmers cultivate these seeds in different parts of their farms in order to ensure that if one loses these seeds or the crop, the other will be able to replenish. This is another device for spreading the risk, and it, was reported by some farmers from Al Gafil village in E. Kordofan.

The farmers' union also was involved in distributing a quick-maturing variety of sorghum to the farmers of Al Ayit R.C. in E. Darfur in 1982. It was called ***Huggana***, and it takes only 60 days to reach maturity. ***Huggana*** was meant to alleviate the problem of grain shortage during the rainy season. The significance of this action is that it was one of the very few formal involvements by a legal enterprise in the distribution of new quick-maturing varieties. The government agricultural research centre at Al Obeid, after four years of experiments, also distributed in 1981 some samples of quick maturing and bird tolerant variety of ***dukhn Abu Sofa*** (Serere composite-2) to some farmers in Al Obeid area.

The farmers were asked to identify the sources of the new crops. The vast majority of the respondents (65.2%) mentioned the mechanized schemes of the Gadarif and the Nuba Mountains (Figure 7.1). As mentioned previously, most of the farmers migrated to these places to work as agricultural labourers. These schemes not only provided the farmers with work and money during periods of drought, but also with ideas and new crops. The significance of this is that information and new ideas were not channeled to the peasant farmers through educational and experimental institutions, but rather through contact with sources of information (mechanized schemes) by the farmers themselves.

Some 17.9% responded that the new crop was brought from the northern part of this region. They refered to ***hirahri*** which was first brought to the northern part of E. Kordofan ***Dar Ar Reeh***. From there it diffused to all parts of the region (Ibrahim 1977).

Some 12.5% brought it from a town or a nearby central village.

Those who adopted new crops were asked whether the new crops were substitutes for old ones. More than three-quarters of the respondents answered "Yes." Farmers were asked to identify the substituted varieties. The vast majority (95%) substituted a new variety. This indicates that in order to cope with the short rainy season, the peasant farmers were substituting newer quick-maturing varieties for old late-maturing varieties. It was clear to them that the late-maturing varieties could no longer yield in the new environment caused by the current drought.

7.6.1.2 Attitude towards new and old varieties

This section examines how the peasant farmers feel about the new and old crops and whether or not that influences their behaviour. Respondents were asked to what extent they liked the new crops. Almost all those who had adopted new varieties answered that they liked the new crop(s). Farmers also were asked to outline the reasons why they liked the new crop(s). Again, almost all respondents replied that they liked the new crop because it is a quick maturing variety:

> "I like it very much . . *Allah* . . *Allah* . . you can harvest it "*Fi butn Al Khareef*" (in the middle of the rainy season)."
>
> "How come I didn't like it and my children livelihood depends on it."
>
> and
>
> "I like it very much. It is called *hirahri* "growing very fast". Before the end of *Al Khareef* you put your money in your pocket."

In contrast, respondents were asked how much they liked the old crop. The vast majority of the farmers who adopted the new crops (71.4%) did not like the old one. Alternatively, 28.6% replied that they liked it.

Respondents who were pleased with the old crop were further asked to point out the reasons as to why they liked it. Table 7.8 illustrates that most of the respondents mentioned the old variety was heavier in weight. They were referring particularly to the old variety of sesame

TABLE 7.8

Reasons why farmers like the old one

Response	N	% of sample	% of responses to the question
Heavier in weight than the new variety	15	3.3	46.8
Light in colour, easy to digest and looks more better	13	2.9	40.6
It brings more money in the market	2	0.5	6.3
Weeds do not harm the plant	2	0.5	6.3
Total	32	7.2	100.0

in comparison with hirahri or "quick-maturing." The old one was named *Tageel*, which means heavy. Above forty percent of the farmers praised *Shuroba* (late-maturing variety of *dukhn*) more than *dimbi* (quick-maturing) by stating that it was light in colour, easy to digest and looks better. In contrast, *dimbi* was dark, and not easy to digest.

Those who adopted the new crop(s) were asked whether they would recommend the new crop(s) for other farmers. The overwhelming majority of the respondents (98.2%) replied "Yes." When asked to mention the reasons why they would recommend the new crop(s) for other farmers, once again the vast majority (97.3%) of the respondents replied that it was a quick maturing crop.

7.6.1.3 Other factors and adoption of new crops

It was hypothesized that certain socio-economic factors might affect adoption of new crops. Such factors included education, age, mobility, family size, and farm advantage. However, there was no significant association between these factors and the adoption of new crops (Table 7.9 and Appendix 9). Rather it seems that the positive attitude of the peasant farmers towards the new crops was a more important influence, along with their experience with the crops in other areas. Alternatively, evidence of negative attitudes towards old late-maturing varieties of crops suggested that these were not cultivated because of dislike of their poor yields under the present conditions of a short and unreliable rainy season.

The conclusion which can be drawn from the discussion in this section "crop innovation" is that since the farmers of the semi-arid areas of the Sudan perceive the rainy season to be shorter than usual, they have started looking for new quick-maturing crops. This adjustment has proved successful, and a positive attitude by farmers towards those newly introduced quick-maturing crops has emerged. Furthermore, farmers would recommend those crops to other farmers. In this context, the data suggest strong links between attitude and behaviour.

TABLE 7.9

The relationship between the adoption of new crops and education, age, mobility, family size and farming advantages

	the Total sample of the study area	E. Kordofan	E. Darfur
Education	Not significant	Not significant	Not significant
Age	Not significant	Not significant	Not significant
Mobility	Not significant	Not significant	Significant
Family size	Not significant	Significant	Not valid
Farming advantage	Significant	Not valid	Not significant

Not valid = When cells with E.F. <5 are more than 20% and no cell should have E.F. less than 1.

1. See Appendix (8)

This example of crop innovation in central Sudan contrasts with the notion that "peasants are poor innovators," which was suggested by other studies such as Lewis (1951), Erasmus (1961), Foster (1973) and Clawson (1978). Instead, the finding of this study supports the notion that "peasants are good innovators," which was suggested by other studies such as Mohamed (1982).

In conclusion, the peasant farmers were able to make a successful adjustment in response to the persistent current drought. Such adjustment is based on a full awareness and an accurate perception of the aggressive nature of drought, especially in the 1980s. At the preparation level, the peasant farmers prepare themselves for drought by buying grains and preparing their fields for a new agricultural season. In addition, they carry out certain off- and on-farm adjustments. Migration to irrigation or mechanized schemes, or to nearby villages and towns in order to look for jobs, is the single most important method of off-farm adjustment to drought hazard.

On-farm adjustments to drought were adopted by the farmers with the aim of maximizing moisture utilization and minimizing moisture waste. One measure adopted includes *remal* (dry planting prior to the rainy season). Some farmers adopt this adjustment in order to try to prolong the perceived short rainy season, while for others, it is a means to increase farm size. To others since *remal* is adopted in order to enable farmers to go and look for work on other farms. Farmers adjust the time of cultivation in order to avoid the risk of drought, wind, insects, and birds.

Other on-farm adjustments to drought in order to maximize the use of rain water include mixing of crops, replanting, intercropping, seeds dressing, farm fragmentation, changing of farm location, and weeding.

Farmers are not passive in their response to drought. As drought begins to intensify, this encourages the farmers to be more aggressive in their response. For example, farmers introduced many new quick-maturing crops to replace the poor yielding late-maturing varieties - the quick-maturing crops are best suited to the short rainy season. A positive attitude has developed among the farmers towards these new crops, which has led to a spread in their use. In addition, perception of adjustment by the farmers tends to be traditional, manifested in praying and offering sacrifices for *Allah* (S.T.) in order to bring rains, migration, and buying of grains.

7.6.2 Pastoral nomads specific adjustments

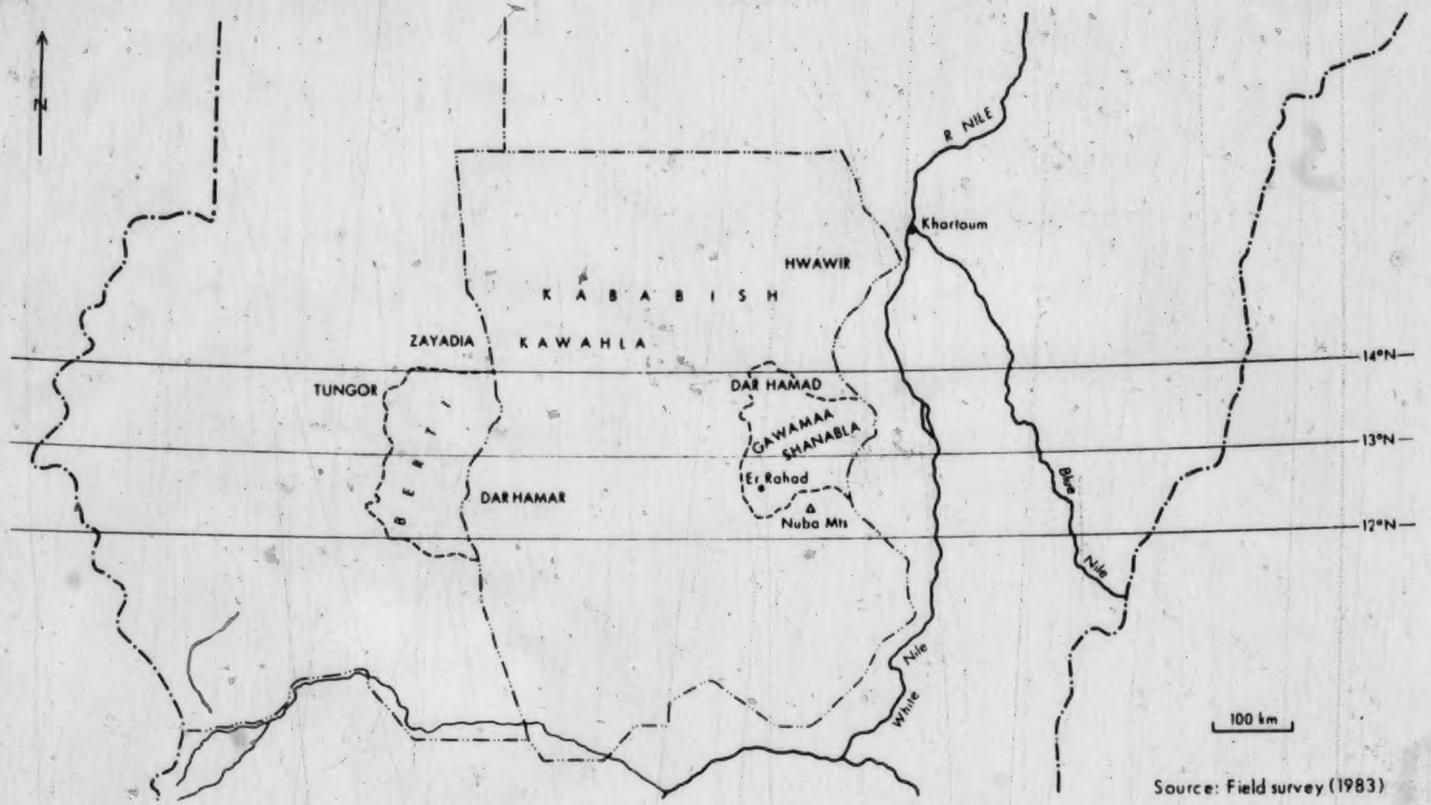
The pastoral nomads also made a series of specific adjustments. These were migration, selling of animals, and buying of grain.

7.6.2.1 Nomads migration

In order to find out the effect of the current drought on migration to the usual *damer* places (areas where nomads spent the dry summer), the nomads were asked where they had spent the summer. Almost half of the nomads (46.2%) had not changed their *damers* for at least the last five years (since 1978 or before). However, 43.3% had changed their *damers* within the last four years (1979 or after). It is believed that the latter were nomads who were most affected by drought, and therefore responded by moving into new areas.

In order to gather information about the grazing grounds and the usual places of *damers*, nomads were asked to identify the locations of their grazing grounds (Figure 7.6) and to point out areas where they usually spend the summer. More than half of the nomads (54.8%) used to spend the summer in Dar Kababish and the northern part of the the study area (E. Kordofan). As illustrated in Figures 6.1 and 6.2, these areas were severely affected by drought. Therefore, nomads responded to the current drought by joining other groups in the most southerly parts of the study area, where grass and water were relatively available. About one-quarter of the nomads used to spend the summer in the southern part of E. Kordofan, and 13.9% in Dar Berti (E. Darfur).

To see whether the nomads migrated directly from the grazing areas to *damers*, or whether they took an indirect route to those areas, they were asked where they had come


N
R NILE
Khartoum
HWAWIR
K A B A B I S H
ZAYADIA
K A W A H L A
TUNGOR
B E R T I
DAR HAMAR
DAR HAMAD
GAWAMAA
SHANABLA
Er Rahad
Nuba Mts
Blue Nile
White Nile
14°N
13°N
12°N
100 km

Source: Field survey (1983)

Figure 7.6 The grazing ground of the main investigated nomadic tribes

from. The findings revealed that more than half of the nomads (56.3%) migrated directly from grazing areas to *damers*. About one quarter arrived in *damers* from nearby places, while 20.6% arrived from other more distant sites. This result suggests that nearly half of the nomads did not arrive at *damers* directly from their grazing grounds by one specific route. This may indicate that drought has distrupted the usual mode of nomads migration which in most cases took one route from the grazing area to *damers*.

Nomads were asked whether they had arrived at those *damers* for the first time. Almost one-third of the nomads (30.8%) arrived at those *damers* for the first time in 1983. This suggests that the nomads had experienced a severe drought in 1983 to the extent that they changed their usual *damers*.

When asked to identify the reasons why they had moved, the vast majority of the pastoral nomads mentioned the need for grass and water. Contrary to Asad's finding (1964, 1970) that it was the heavy burden of water rather than grass that dictated the southern migration of the Kababish into central Kordofan and Darfur, in this study it was found that the nomads were more concerned with grass than water.

The pastoral nomads were asked whether they moved to the *damers* alone or with their families. It was found that 67.8% moved to the *damers* with their families, which indicates the finality with which they viewed the move. Only one-third of the nomads moved to *damers* leaving behind elders, women and children at the grazing grounds looking after small and weak animals.

Furthermore, the nomads were asked how long they stayed at the *damers*. More than three-quarters of the nomads stayed at the *damers* for a few months, which normally extended until the beginning of the rainy season in July, before they started moving northward. More than twenty percent stayed only for one or a few days. This group, however, represents the portion of the nomads who were interviewed near water points and who came from nearby areas, and who wanted to have access to the water at those points since they had problems with water at their own *damers*. It can be concluded that the length of time the nomads spend at the water points varies between a few months and a few days.

To examine whether the nomads, especially those who moved recently to new *damers*, felt they had made the right decision, they were asked to state whether they were happy with that place. The majority of the nomads (58.2%) answered "Yes." Those who were unhappy were asked to point out the reasons for their unhappiness. The majority mentioned the difficulty of getting water. It is of interest to note that most of the nomads who came from the north (Dar Kababish) had no problem with water supply. They came mainly due to the lack of grass in that area. Paradoxically, they faced both problems when they arrived in the study area:

> "We have no problem of water supply in Um Badir, but that area was suffering very badly from *Mahal* (lack of grass)."
>
> "The water supply in our grazing ground "Dar Kababish" is cheap, but here it is very expensive"

7.6.2.2 Main factors affecting the decision of migration

Many interrelated factors seemed to be responsible for the migration of the pastoral nomads with or without animals. The main factors include drought, lack of grass and water supply, the need for possessing cultivable land (this reason was especially applied to the members of the Shanbla tribe), tax avoidance,[1] and the high demand for veterinary services. Other reasons included accessibility to market, and the need for security, since the rate of theft and armed robberies had increased in northern Darfur and Kordofan (Hummad 1984). Nomads, therefore, migrated to areas free of thieves. However, the most important factor in reaching the decision to migrate for the nomads was psychological. Migration is part of the cognitive make-up of the nomads. As mentioned before, this factor plays an important role in their spatial behaviour. Some nomads migrate in order to find jobs in agricultural schemes, towns or villages (Figure 7.7). For the first time in recent Sudanese history, there was a mass-migration of nomads to temporary camps west of Omdurman (Kaplan (1984) called them refugees in their own country). Some 40,429 nomads from the Kababish, Hwawir and Dar Hamid tribes moved to five temporary camps west of Omdurman (Abd Al Aziz 1984:a). Thus, cognitive dissonance with their surroundings indicates the length to which nomads are prepared to go in order to survive.

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[1] It should be mentioned that during the field survey at Um Dam animal market many nomads avoided talking to interviewers on the assumption that they were tax collectors.

A second adjustment to drought practised by the nomads was the selling of animals. More than three-quarters of the nomads had sold of some of their animals during the last drought. The nomads did not sell all of their animals but only some, because keeping large herds is an important part of nomadism.

Nomads were asked how many animals they sold last year. Findings revealed that 60.6% of sheep keepers sold between one and 30 sheep, and 26.8% between 31 and 60 sheep. Most of the camel owners sold between one and five camels, and 74.5% sold between one and 10 camels. The vast majority (89.8%) of goat owners sold between one and 10 goats annually. The overwhelming majority of cattle owners (80.5%) sold between one and five cattle. This finding, supports the above remark that nomads tend to sell few of their animals during drought. It has been noticed that sales of sheep seemed to be greater than those of other animals, even though most sheep owners sold fewer animals than the owners of other animals (Figure 7.8; 7.9).

7.6.2.3 Nomads and adjustment to drought through settlers' grain

Almost all (99%) of the nomads adjusted to the drought by buying grain from the settlers. Nomads were asked to show how many sacks of grains they had bought for the period 1978-1982. The data presented in Figure 7.10:A indicate that from 1979 until 1982, almost three-quarters of the nomads bought between one and 30 sacks of grain. This result indicates that the dependence of the nomads on the settlers' grains has increased steadily since 1978. In contrast, almost half of the nomads did not buy grain in 1978. This ratio

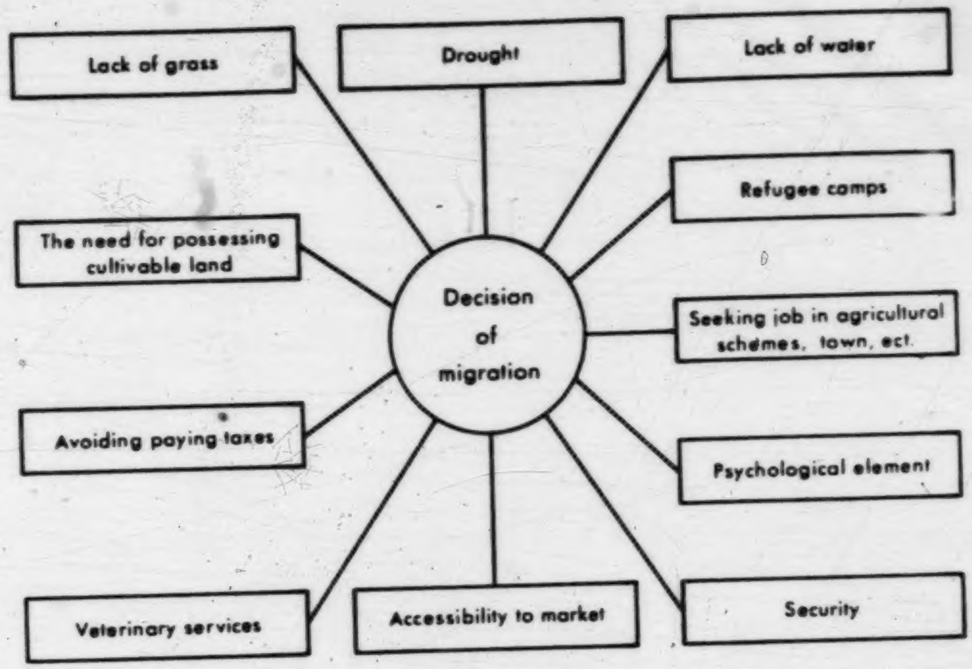
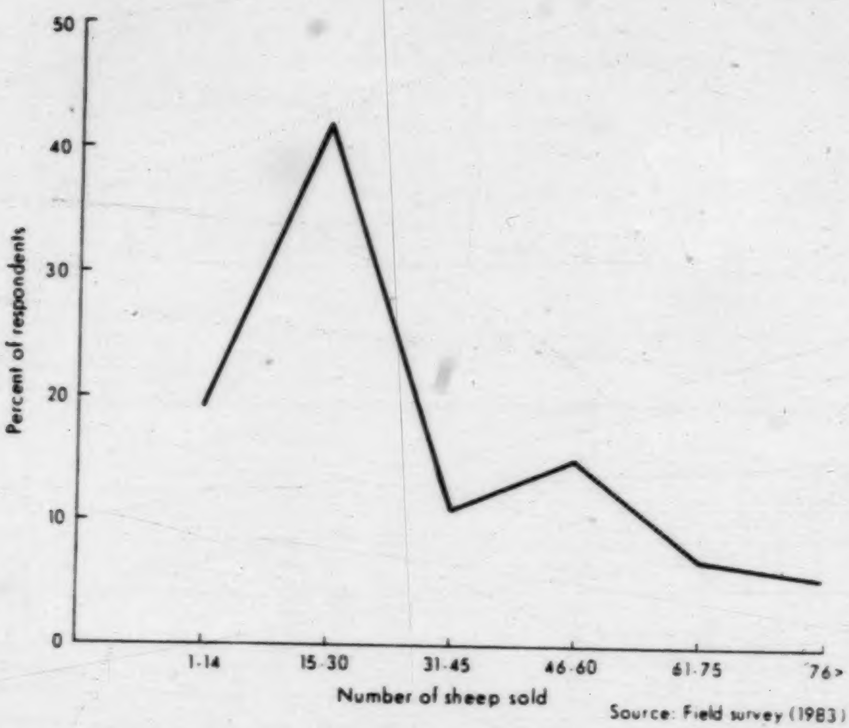
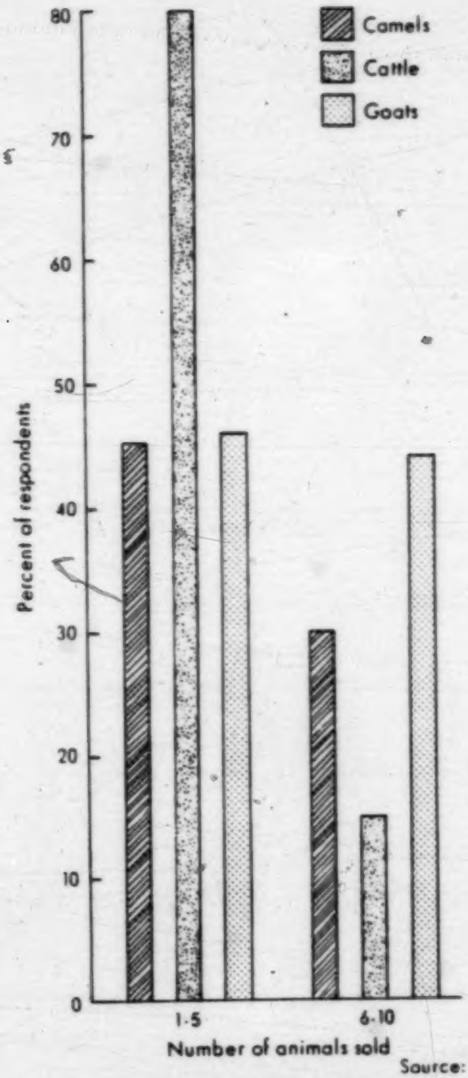

Lack of grass
Drought
Lack of water
Refugee camps
The need for possessing cultivable land
Decision of migration
Seeking job in agricultural schemes, town, ect.
Avoiding paying taxes
Psychological element
Veterinary services
Accessibility to market
Security

Figure 7.7 The main factors affecting the decision of migration by the pastoral nomads



Source: Field survey (1983)

Figure 7.8 Number of sheep sold by the pastoral nomads in 1982



Source: Field survey (1983)

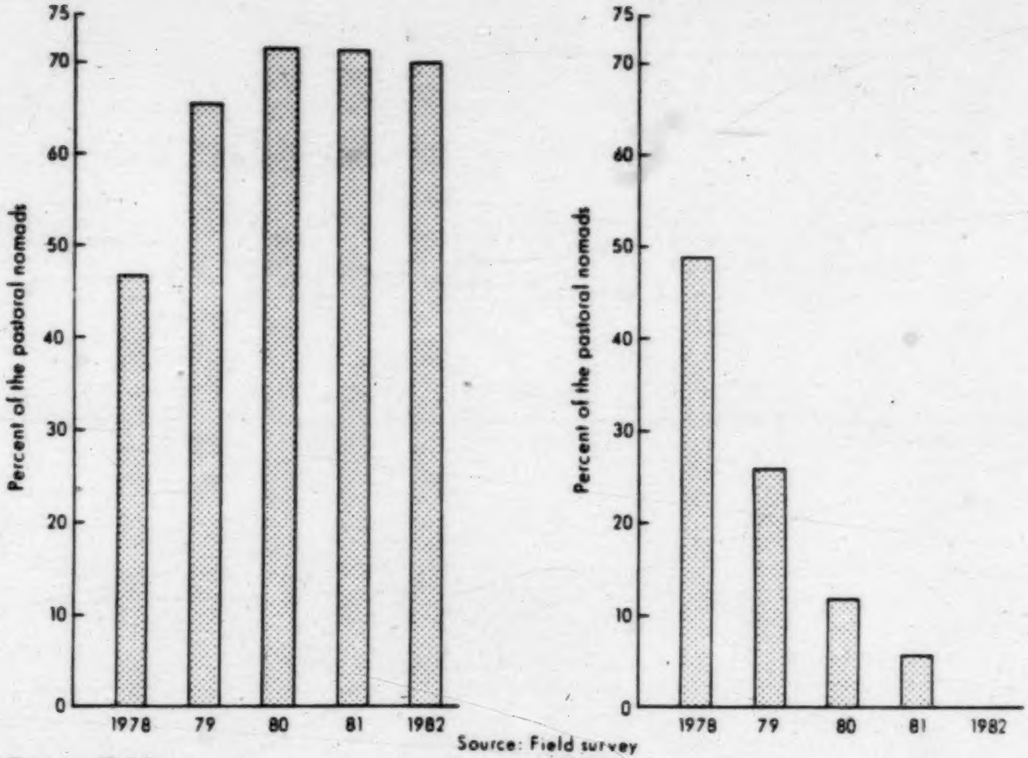
Figure 7.9 Number of camels, cattle and goats sold by the pastoral nomads in 1982

declined to the extent that in 1982 all nomads bought grain from settlers (Figure 7.10:B). This result reflects the severity of drought in these years.

Pastoral nomads were further asked whether the grains bought were for family consumption, or for animals or farming. The vast majority (96%) indicated that they first use grains for family consumption, and secondly for animals (73%). Only weak or small animals were fed using grain.

Nomads were asked where they bought the grain. Most of the grain (75%) was bought either from a nearby town or a nearby central village and only 16% from transports along roads. The remainder of the grain was acquired in far away towns and villages. When asked whether this grain was easy to obtain, the vast majority (83%) mentioned that they had no problem in obtaining grains. The vast majority (82.3%) of those who found some difficulty in getting grain mentioned that grain prices were very high, and that grain had to be brought from a considerable distance.

The current drought has had its adverse effects on the nomads to the extent that they adopted specific adjustments in order to cope with drought. The single important adjustment to drought hazard adopted by the nomads is migration. Nomads spend the summer in *damer* places. As an adjustment to the current drought, a considerable percentage of the nomads (43.3%) changed their damers in the last four years (1979 and after). Migration satisfied four needs of the nomads: environmental, economic, social, and psychological needs. Findings revealed that the nomads sold only few of their animals, which is a reflection of the nomads' attachment to their animals. Nomads also adjusted to drought by buying grain from settlers. Since 1978, the nomads' demand for grain increased steadily until 1982. The period also recognized as that of severe drought. Grains were bought mainly for family consumption, and for weak and small animals as well. The majority of the nomads found no difficulty in obtaining grain, which was mostly bought from nearby towns or central villages.



Source: Field survey

Figure 7.10

A) Percent of the pastoral nomads who bought between 1-30 sacks of grain annually during the 1978-82 period

B) Percent of the pastoral nomads who did not buy grain during the 1978-82 period

7.7 Common adjustments made by both groups:

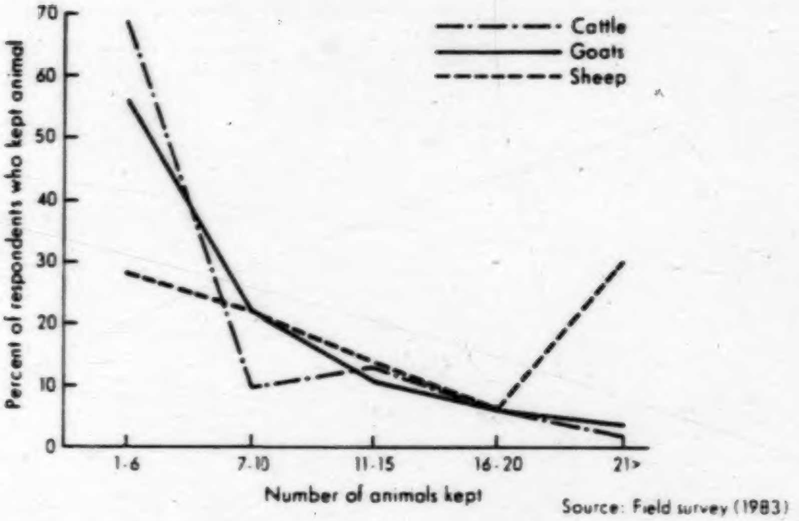
Cultivation of crops is basically the peasant farmers' profession, while keeping animals is the profession of the nomads. At some stage, the keeping of animals by farmers and the cultivation of crops were adopted by both groups as forms of interchanging adjustments to the environment.

7.7.1 Animals that are kept by the farmers

The peasant farmers were asked whether or not they kept animals. The overwhelming majority answered "Yes." When asked to identify the sorts of animals, it was found that the majority kept goats and donkeys (Table 7.10), while the vast majority of the nomads kept sheep, camels, and goats. The peasant farmers were asked about the number of animals they kept. The answer to this question is presented in Figure 7.11. The majority of the owners of cattle, goats, and sheep tended to keep between one and six animals. The graph declined steadily towards bigger numbers (21 >) except for sheep owners. A large percentage of sheep owners (30.0%) kept more than 21 sheep. Furthermore, the majority of the peasant farmers kept between one and two camels and or donkeys.

To understand the role played by these animals during times of drought, respondents were asked what they did with their animals in times of drought. The vast majority (81.8%) sold some of them, but 14.0% kept all of them. These animals were kept mainly for milk. However, the majority of the farmers (77.5%) sold animals to buy grain, and one-fifth of the respondents said they were in need of cash:

> "Animals became the main source of our living, what else do we have?"
>
> "Our crops failed, and I am an old person. I cannot migrate to other areas for work. What can I do other than selling my animals?"
>
> and
>
> "I will keep selling them until I finish them all. Now I have only one goat and my donkey. Next time I will sell the goat."
>
> The author: "From where do you get milk?"



Source: Field survey (1983)

Figure 7.11 Number of animals owned by the peasant farmers

The respondent: "From the market."

When asked about the number of animals the farmers sold, it was found that most of goats owners sold between one and three goats and the majority (70.6%) sold between one and six goats. Most sheep owners sold between one and five sheep and the majority (77.8%) sold between one and 10 sheep. The vast majority of cattle owners (79.8%) sold between one and six cattle, and most camels and donkeys sold between one and two animals.

In conclusion, it appears that the peasant farmers kept animals to play different roles. Animals are kept to provide milk, milk products, meat, and are used for transportation and for cash when needed. All types of animals, with the exception of donkeys, can satisfy all of these needs. Basically, goats and cattle were kept to provide milk for the farmers and his family. Sheep were kept for sale, and donkeys and camels for transportation. Farmers sold animals mainly to buy grains, especially during drought. The number of animals sold was very small, except in regard to sheep, which were kept mainly for this purpose.

7.7.2 The pastoral nomads and cultivation

Nomads were asked whether or not they cultivated crops. More than half of the respondents (58.7%) answered "Yes," and 41.3% "No." Most of those who answered "Yes", cultivated ***dukhn*** (millet) and sesame. It is clear that ***dukhn*** is cultivated as the staple food since sorghum (***zenari*** or ***marag***) is not popular among the nomads:

> "We eat ***dukhn***; we didn't like ***zenari***"
>
> "If ***zenari*** is cultivated, it will be cultivated to feed animals."

Nomads were asked to report the area cultivated by each crop. Half of ***dukhn*** cultivators cultivated between one and five ***mukh***. of ***dukhn***, while the majority of farmers cultivated between one and 10 ***mukh***. of ***dukhn***. One-third cultivated between six and 10 ***mukh***. of ***dukhn***. Almost half of the sesame cultivators (45%) cultivated less than two ***mukh***. of sesame, and one-third cultivated between three and six *mukh*. of sesame. However, 19 out of the 26 respondents who grew *waka* (okra) cultivated less than one *mukh*. Five out of nine respondents who grew water melon in 1982 cultivated between six and 10 *mukh*. Many of the nomads did not grow some of these crops in 1982. Field surveys by the author in 1978 and 1983 revealed that agriculture was not part of the normal pattern of living for most of the nomads before the current drought. Many nomads recently interviewed have acquired or were looking for a piece of land to cultivate, which indicates a growing dependence on agriculture by the nomads.

To a large extent, records of crop yield seemed to be like those reported by the peasant farmers. The vast majority of the nomads (80%) either subjected to a complete crop failure (less than one sack) or semi-complete crop failure (one to three sacks).

7.8 Interaction between the farmers and nomads

Although the peasant farmers and the pastoral nomads are two distinct groups, in most cases they share the same tracts of land. This sharing necessitates some sort of commercial interaction, which may increase or decrease according to the local circumstances. Interaction of adjustment may take some or all of the following forms:

7.8.1 Ongoing interaction

1. Most peasant farmers keep the same animals as those kept by nomads.
2. Some nomads cultivate crops. Crop cultivation is basically a peasant farmers' profession.
3. The farmers sell their products (grain) to the nomads, and in turn the nomads sell animals and animal products to the farmers.
4. In many cases both groups share the same source of water supply, the market, health care centres, educational institutions, and some other social services.

7.8.2 Interaction of adjustments to drought

1. The peasant farmers benefited from times of drought, by selling their grain at high prices to nomads. Because the nomads' demand is so great, grain prices rise and grain becomes less affordable to poor farmers.
2. Before years of drought, water melon was cultivated mainly by peasant farmers who sold the melon seeds, and also as an additional source of water supply in early summer. But in recent years, because it yielded very poorly, water melon started to play another role for both groups. The farmers grew it to sell to the nomads as a source of water supply and fodder for their animals. This helped the nomads with a cheap source of water and fodder. This proved to be an advantage to the nomads because they could avoid the expensive and overgrazed boreholes.
3. Introduction of nomads' animals into farms may increase soil fertility through the use of manure, which in turn may increase land productivity.
4. The introduction of animals to farms in this spontaneous and unplanned way may lay a strong basis for a more systematic way of combining animals and crops in one form (mixed farming).
5. The field survey revealed that some of the nomads who had lost their herds adopted cultivation as a new way of life (e.g., some of the Shanabla and the Kawahla)
6. Ultimately, this interaction is part of the ecosystem of the semi-arid areas. But in some cases, this interaction of adjustment between the different groups has increased to the point where it has led to some clashes due to conflicts of interest.

7.8.3 Adjustment and conflict of interest

To assess the degree of interaction of adjustment, the pastoral nomads were asked whether there were quarrels between themselves and the farmers. Thirty-eight percent of the respondents answered "Yes." A significant difference was observed between the nomads of E. Kordofan and E. Darfur (Table 7.11). The majority of E. Kordofan nomads compared with

TABLE 7.10

Animals that kept by the farmers

Response	N	%
Goats	308	69.4
Donkey	283	63.7
Cattle	177	39.9
Camels	130	29.3
Sheep	95	21.4

* Respondents were allowed to give more than one answer.

TABLE 7.11

Were there any quarrels between you and settlers?

Response	E. Kordofan		E. Darfur	
	N	%	N	%
Yes	76	67.9	3	3.1
No	36	32.1	93	96.9
Total	112	100.0	96	100.0

Chi-square = 89.227; d.f. = 1; $P < 0.0000$

only 3% of E. Darfur nomads mentioned that they have some problems with the farmers. One possible explanation for this is that nomads (the Shanabla) and settlers (the Gawamaa) are living together in E. Kordofan, which may increase the contact between them. In E. Darfur they do not live in close proximity, and the contact between them is minimal. Also the population density in E. Darfur is low.

Nomads were asked to point out the reasons for quarrels. Findings revealed that quarrels either occurred when animals caused crop damage, or in the water yards. However, passing with animals through farms needs an extra labourer, usually the nomad overcome this difficulty with the help of their children.

When asked how they solved these problems, nomads suggested they solved them through private compromises. These compromises either were made through the payment of some money (one Sudanese pound for each animal entered into the farm), or a friendly talk between the two with no fine.

In conclusion, it could be said that it is very natural to find some sort of interaction whenever two groups are utilizing the same natural resources. Harmony existed between the farmers and the nomads in the adjustment to the environment, but it tended to develop into conflicts of interest sometimes. However, when clashes arose, those clashes tended to be solved in a friendly manner. Interaction of adjustment is thought of as complementary and beneficial to both groups, and as part of the ecosystem of the semi-arid areas.

7.9 Farmers and nomads' attitudes towards adjustments adopted

In the current drought, many adjustments were adopted by both the peasant farmers and the pastoral nomads. In order to determine to what extent the two groups were satisfied with the type of adjustment they had adopted, the peasant farmers were asked if they would adopt the same adjustments in any future period of drought. Eighty-six percent of the farmers stated they were satisfied with their adjustments, and that they would adopt them again. This result suggests that the peasant farmers have developed a positive attitude towards the adjustments they have adopted.

As previously mentioned, the main adjustment to drought adopted by nomads is migration to *damers*. The nomads were asked whether they would like to stay premanently in the *damers*, go back to their grazing ground, or go somewhere else. The majority (61.1%) of the nomads replied they would like to go back to their grazing ground. However, this answer does not show whether they were satisfied with the adjustment or not, because going back to one grazing ground is part of the normal migration system. However, because the majority of the nomads previously replied that they were happy with their present *damer* places, we may conclude that the majority of nomads are satisfied with their adjustment.

However, almost one quarter of the respondents replied that they would go elsewhere, which may indicate their dissatisfaction. When asked to identify other areas they might go to, 80% of these people replied that they would like to go to the south. This finding concurs with the trend of migration to more southern areas.

It can be concluded that the vast majority of the peasant farmers and the pastoral nomads seem to be satisfied with the adjustments they have adopted, and possibly will adopt again. This indicates a strong relationship between positive attitude towards adjustment, and adoption of adjustment.

7.10 Adverse affect of adjustment

Ironically, the disruption of the ecosystem of the semi-arid areas created by the current drought has been further increased by man in the course of adjustment to the drought hazard. Such harmful adjustments can be summarized as follows:

1. In the late 1960s and the beginning of the 1970s, many boreholes were opened in western Sudan (Chapter 2). These boreholes solved part of the problem in some areas, yet created another problem. This is the desert-like condition which resulted around water points. Large herds were using these water points and consumed most of the vegetation cover around them. Consequently, bare soil surfaces were exposed to wind erosion, which helped

in the process of desertification. In addition, the concentration of large herds at one place also increased the possibility of disease outbreak, which may be harmful to the national wealth.

2. In recent years some rich farmers have cleared large areas of vegetation in order to increase their farm size so that they can cope with drought and make more money in order to meet the demands of their families. This action, however, has its adverse effects on both soil and the environment, because it will increase the degree of desertification.
3. The current drought has increased the rate of rural-urban migration. This migration affects both the urban centers and rural areas. Some rural areas are subjected to an increasing rate of depopulation as occurred in 1982, 1983, and 1984 (Abd Al Aziz 1984:a; Field Survey 1983; Hulme 1984). It is not yet known whether all 40,429 drought victims on the camps (Abd Al Aziz 1984:a) west of Omdurman will go back to their areas in western Sudan. This type of migration has it adverse effects on agricultural productivity.
4. The past decade has witnessed the movement of the *Abbala* (camel owners) further south into the *Baggara*(cattle owners' homeland) because of drought (Abdalla 1983:a; Qotbi 1982). In order to remain over the summer, nomads chose areas beside water points and set fire to the grass. By doing so they eliminated the *Baggara* from using these areas, because cattle can only graze relatively tall grass. Later the *Abbala* came, and their camels found plenty of food in the form of tree leaves (Musa 1978).

Such animosity may harm the ecology of these areas, since vast areas are burned. Similarly, these factors may trigger problems between both groups, which could develop into tribal conflicts. These are the obvious examples of an adverse affect of adjustments to drought hazard.

7.11 Assistance received during periods of drought

Farmers and nomads were asked whether or not the government did anything to reduce the effect of drought. Both groups answered "No."

Both the peasant farmers and the pastoral nomads were also asked whether they had received any help during times of drought. Differences were observed between the two groups. All of the nomads compared with the vast majority of the farmers (89%) answered "No." (Table 7.12). The majority of those who answered "Yes" mentioned that they received help from sons and brothers. About 10.2% mentioned help from the Agricultural Bank. Farmers were asked to mention the kind of help received. The majority (77.6%) replied "money." More than one-fifth of the respondents mentioned "loans' and "grain." When asked to identify the source of help, 83.6% answered sons and relatives. This indicates that in the absence of relief programmes, drought victims depend on their immediate family members and relatives.

Only a few depend on loans from the Agricultural Bank, which has extended its services to the peasant farmers since 1979. The loans help in cleaning land, sowing, weeding and harvesting. These loans are required to be paid back within five months after harvesting, with an interest (services) of 12-13%. Those who are unable to pay their debts in that period will forfeit the bank services in the future.

Nomads who lost their animals would be helped by other members of the tribe. This help took the form of gifts of animals, the number reaching the same number that the dispossessed owner previously kept. But under the current drought conditions, many nomads have lost their animals (Abd Al Aziz 1984:a; Field survey 1983) and they could not find help from others because they were in the same situation. A comment frequently heard was:

> "Who would help you? Those who are supposed to help had the same problem."

TABLE 7.12

Did you receive any kind of help during drought times?

Response	Peasant farmers N	%	Pastoral nomads N	%
Yes	49	11.0	0	0.0
No	395	89.0	208	100.0
Total	444	100.0	208	100.0

Chi-square = 23.257; d.f. = 1; $p < 0.0000$

7.12 Summary

The inhabitants of the semi-arid areas of the Sudan have developed certain strategies to cope with high variability of rainfall and sporadic droughts. These strategies originated in the 1950s through a cumulative knowledge of trial and error which created a degree of equilibrium with the environment (Hidore and El Tom 1975). In recent years, notably during the current drought years, all of these strategies have been reconceptualized and reframed, or otherwise modified, to be carried out as adjustments to drought hazards. Other adjustments emerged only during recent years as a response to the current drought (e.g., diffusion of quick maturing crops). All of these adjustments were adopted in the belief that they would minimize the risk of drought, and maximize the opportunities offered by the environment. It was found that the inhabitants of the semi-arid areas (farmers and nomads) adopted certain methods of adjustment to cope with drought hazard before and during the event.

At the preparation level, the most commonly adopted method of adjustment was the buying of grain. In order to prolong the short period of the rainy season, peasant farmers were cultivating dry "*remal*." Contrary to this, some abandoned this technique as they felt the inadequacy of pre-season rains (May and June) and the harmful effect of birds, rodents, and insects on the buried seeds. Perception of adjustment by farmers and nomads tended to be more traditionally and culturally oriented adjustments (praying, sacrifices, migration, and buying of grain).

Specific adjustments were adopted by both farmers and nomads. The farmers carry out different on-farm adjustments. By doing so they aimed at maximizing moisture utilization and reducing moisture waste. These adjustments include selection of proper seeds (mostly seeds of quick-maturing crops), and the number of crops cultivated. The time of cultivation was carefully planned in order to avoid the risk of drought, wind, insects, and bird hazards. Mixing of crops, intercropping, replanting, weeding, and changing of location were all adopted and carried out in different ways in order to reduce the effect of drought. Seed dressings also were adopted in a variety of ways so as to reduce the effect of drought, birds, and insects. Adoption of new varieties of crops (quick-maturing) to replace the old, late-maturing varieties gained a wide popularity among the peasant farmers, especially during the years of the current drought.

On the other hand, the single most important method of adjustment adopted by the nomads and the farmers in case of crop failure is migration. Since the early beginnings of the current drought in the 1960s, the nomads of the semi-arid areas of the Sudan, notably the *Abbala* (camel owners), had reversed their seasonal migration southward (South 14°N). Such migration used to take place north and northwest. As a response to the severest years of the current drought in the late 1970s and the early 1980s, the nomads have extended their migration approximately 150 Km further south. They entered into the *Baggara* (cattle owners) homeland. The cost of this latest adjustment was very high, as camels did not adapt easily to that environment. This difficulty in adaptation was due to the new species of vegetation, new soil (clay), and exposure to new diseases. Moreover, some animals found it very difficult to survive, causing these animals to return alone to their homeland. In addition, interaction between camels and cattle owners create a tribal conflicts between the two groups. The pastoral nomads also adjusted to drought by depending on farmers' grain and selling some of their animals.

The peasant farmers and the pastoral nomads diversify their adjustments to drought. For example, the peasant farmers keep some animals, and some of the pastoral nomads cultivate some crops. Almost all farmers supplemented their on-farm earnings with off-farm income. They either look for jobs locally (village or a nearby village or town) or in distant areas (agricultural schemes or cities).

The interaction between the farmers and the nomads in their adjustments was inevitable, since they live on the same land and share most of the natural resources and social services. Both groups realized that interaction was advantageous. The field survey revealed that any kind of conflict of interest tended to be solved in a friendly manner.

Some of the adjustments had adverse effects on the environment, such as overgrazing around water points, over-cultivation, cutting of trees, and burning of grass by the nomads.

Apart from the 1984 drought assistance, victims received help from their immediate family members and relatives, or from other members of the tribes.

The findings suggest that there is a close relationship between cognitive processes and human spatial behaviour (adjustment). The most obvious examples of these processes were attitudes, beliefs and perceptions. The effect of attitude on human spatial behaviour was demonstrated very clearly by the introduction and adoption of new crop varieties. The peasant farmers have developed a positive attitude towards the new crops (quick-maturing). They explained this by the fact that these quick-maturing crops were best suited to the short rainy season, and thereby reduce the risk of drought hazard. In comparison, the farmers developed a negative attitude towards late-maturing varieties and ceased cultivating them, since they yielded very poorly or not at all in the current drought years. The majority of both farmers and nomads have developed a positive attitude towards their previous adjustments and are likely to adopt the same adjustment again. It was found in E. Darfur that beliefs hindered the peasant farmers in their cultivation of the quick-maturing, bird-tolerant variety of millet (*dukhn Abu Sofa*). These beliefs also affected the farmers' perception of lessening and overcoming the problem of drought through an increased dependence on rain prayers, and sacrifices to *Allah* (S.T.). In addition, the use of some verses of the holy Quran for seed dressing were used in order to reduce the risk of drought, birds, rodents, and insects. Furthermore, all of these adjustments were adopted by both groups in order to cope with the short rainy season and the current drought conditions. Such behaviour was based on both a knowledge (awareness) and perception of the risky environment within which they were operating. It is therefore reasonable to believe that the findings in this study suggest a strong link between perception, attitude and beliefs, and adoption of adjustment to drought hazard, in particular, and the environment in general.

There has been a lack of knowledge in the literature in terms of adjustments of farmers and nomads to the current African drought, and the relationship between the perceptions, attitudes, beliefs, and adjustment to drought hazard by farmers and nomads in particular. The information presented in this chapter fills some of this gap in the literature and research. None of the existing literature and research has presented a thorough examination of this information. This study contributes to the literature because the data come from one of the most prominent areas affected by the current African drought.

Chapter 8

Adjustment of Government Officials to Drought Hazard

8.1 Introduction

This chapter discusses the perception of and adjustment to drought hazard by officials of the Sudanese government. It examines the awareness and experience of drought by policy-makers as well as their perceptions of the intensity of drought. State policy and the responsibility of different levels of government officials for drought adjustment is investigated. Drought relief plans also are examined together with the policy-makers' perceptions of adjustment and the steps undertaken to develop traditional agriculture. It also discusses the differences in perception of and adjustment to drought between resource users(farmers and nomads) and policy makers (government officials).

8.2 Perception of drought

To examine their awareness and how they rate drought among other problems the government officials were asked about the main agricultural problems. Almost all government officials agreed that drought was the top problem, followed by desertification. This finding indicates that government officials are well aware of the problems both of drought and desertification. Insects were mentioned by almost half of the respondents, and 18% identified crop damage by animals (Table 8.1).

Respondents were asked whether or not they experienced drought. The vast majority (88%) answered "Yes." When asked in which years, more than three-quarters mentioned 1982. Some 42% answered 1981. More than one quarter answered 1980 and 18% answered 1979.

The data presented in Table 8.2 indicate the vast majority of the government officials perceived that the intensity of drought had increased. Only 10% thought it had decreased.

When asked what indicated that the area was experiencing drought, most government officials mentioned that there were a sharp decrease in crop yields, and animal productivity.

TABLE 8.1

What are the main agricultural problems?

Response	N	%
Drought	49	98.0
Desertification	36	72.0
Insects	24	48.0
Crop damage by animals	9	18.0
Wind	7	14.0
Rodents	3	6.0
Lack of improved seeds	3	6.0
Crop marketing	2	4.0
Other	9	18.0

* Respondents were allowed to give more than one answer.

TABLE 8.2

Do you think drought increased or decreased or remained the same?

Response	N	%
Increased	43	86.0
Decreased	5	10.0
Remained the same	2	4.0
Total	50	100.0

This result may indicate that policy-makers perceive drought as a sharp decrease in crop and animal productivity. Some 32.0% mentioned scarcity of rainfall and desertification, and 16% mass out-migration mainly to the south (Table 8.3). The few who perceived that drought had decreased mentioned that the rain had improved. The above result suggests that the government officials are well aware of drought, and rate it as a primary problem facing farmers and nomads in the Sudan. Similarly, the majority of government officials had experienced years of drought, and perceived that the intensity of drought had increased. They also perceived that drought intensity was reflected in the sharp decline in crop yields and animal productivity, as well as in the scarcity of rainfall, desertification, and mass out-migration.

8.3 Adjustment to drought hazard

> Since the beginning of the 1970s there has repeatedly been a problem of *dura* shortage, to the extent that famine threatened every year. There was temporary solution in the form of shipments of *dura* from Al Gadarif and Kosti to try to alleviate the problem. There is no permanent solution to this problem (Dosa 1982).

The above statement by the regional minister of agriculture of Darfur region implies that before the 1984 drought there was neither a national nor a regional policy to cope with drought. The only form of government involvement in solving the drought problem was the shipment of *dura* from mechanized and irrigated schemes of central and eastern Sudan to drought stricken areas of Kordofan and Darfur regions (Figure 7.1).

Government officials were asked whether or not the government did anything to reduce the effect of drought. The majority of the respondents (58%) answered "No." Most government officials who answered in the affirmative mentioned that grain was brought some distance. Some 14.3% mentioned provision of water supply through tanks. Also, 14.3% responded that grain was distributed freely to drought victims (Table 8.4).

The government officials were further asked to state when assistance had been provided. As may be seen from Table 8.5, the majority of assistance was provided between 1979

TABLE 8.3

What critically shows that this area is experiencing true drought?

Response	N	%
Sharp decrease in crop and animal productivity	16	32.0
Scarcity of rainfall (< 200 mms)	8	16.0
Desertification	8	16.0
Mass out-migration mainly to the South	8	16.0
Drying out of trees	5	10.0
Eating of mikhat (Boscia senegalensis)	3	6.0
Lack of water supply	1	2.0
Nomads entered places in the South where they haven't been to before	1	2.0
Total	50	100.0

TABLE 8.4

What kind of help that has been given?

Response	N	% of sample	% of responses to the question
Grain were brought from distance	8	16.0	38.1
Provision of water supply through tanks	3	6.0	14.3
Distribution of some free grains	3	6.0	14.3
Feasibility studies to hold back sand dunes	2	4.0	9.5
Planting some Acacia Senegal trees	1	2.0	4.8
Animal vaccination	1	2.0	4.8
Distribution of improved seeds	1	2.0	4.8
Other	2	4.0	9.5
Total	21	42.0	100.0

TABLE 8.5

In which year(s) that help has been provided?

Years	N	%
1982	14	28.0
1981	15	30.0
1980	7	14.0
1979	6	12.0
Other	8	16.0

* Respondents were allowed to give more than one answer.

and 1982, with an emphasis on 1981 and 1982. This, however, may indicate the severity of the current drought, which again supports the findings of Hulme (1984).

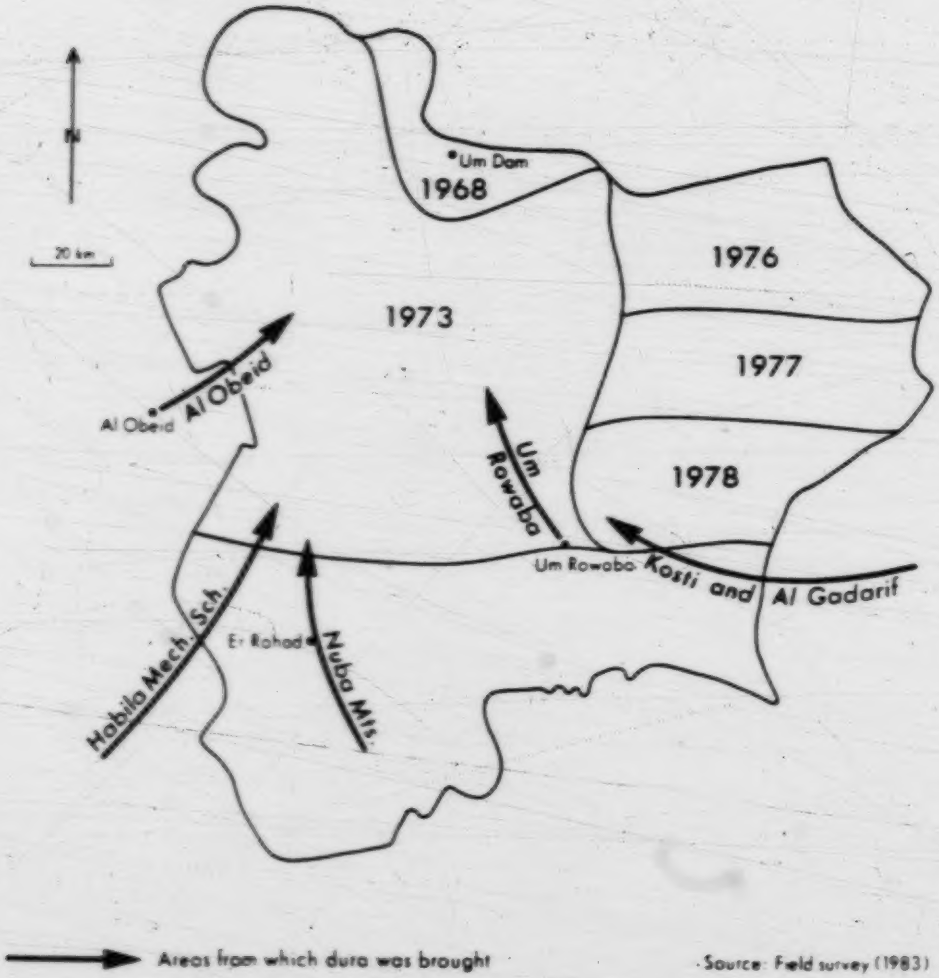
8.3.1 History of relief programmes

The introduction of *dura* as a food grain to drought stricken areas, whether commercially or by regional governments, was the only form of relief programme prior to the 1984 drought.

As mentioned before, *dukhn* (millet) is the staple food for the inhabitants of both E. Kordofan and E. Darfur. However, because of the continuous crop failure during the current drought, *dura* was introduced from mechanized and irrigated schemes.

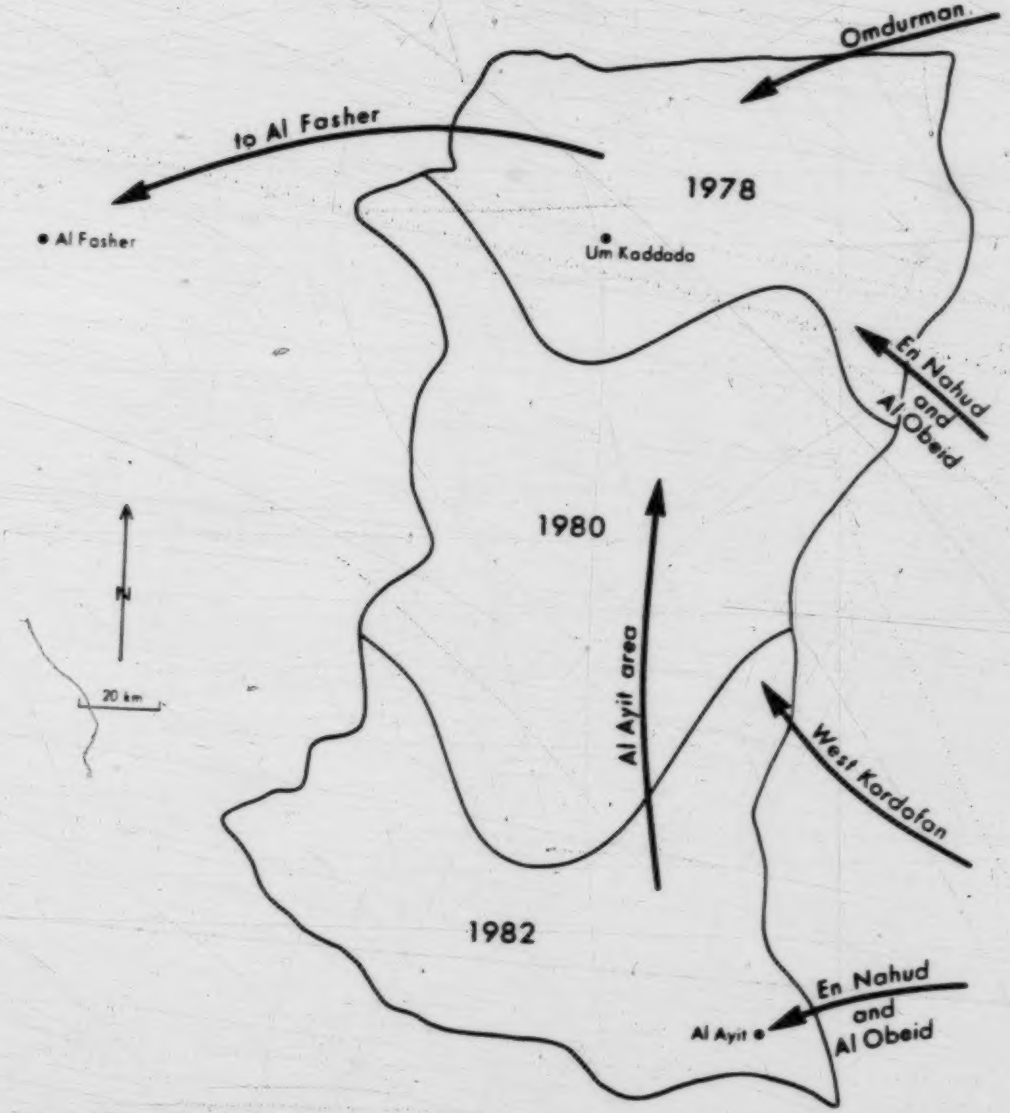
Dura was introduced as a food grain in E. Kordofan in 1966. It was first introduced into the northern part (Um Dam area) which is the most intensely affected part of the region (Figure 8.1) and in the area located to the south of Dar Kababish which felt the effects of drought at that time. The stock of grain was brought from Um Dam which is an important commercial and administrative centre. In general, the number of years in which it was necessary to introduce *dura* decreased to the south of the Sudan (Figure 8.1), because although the drought had extended into the more humid and productive areas of the south, it was not as intense as it was further south. In almost half of the region, *dura* was introduced in 1973. This coincides with the worst year of the Sahelian drought of 1969-73, which was 1973.

Small amounts of commercial *dura* were introduced in the northern part of E. Darfur in 1968-69 from Habila and Al Gadarif mechanized schemes and from towns like Kosti, Um Rowaba, Er Rahad and Al Obeid. In 1978, *dura* was introduced in Um Kaddada in large volumes (Figure 8.2). Similar to E. Kordofan, *dura* was introduced into the central and the southern parts in the following years. Even in the southern part of E. Darfur, which was one of the most productive areas in Darfur region in terms of grain, *dura* was introduced for the first time in 1982. This may indicate the severity of drought in that year. Similar to E. Kordofan, *dura* was introduced generally from the mechanized and irrigated schemes mentioned


N
20 km
Um Dam
1968
1973
1976
1977
1978
Al Obeid
Al Obeid
Um Rowaba
Um Rowaba
Kosti and Al Gadarif
Habila Mech. Sch.
Er Rahad
Nuba Mts.
Areas from which dura was brought

Source: Field survey (1983)

Figure 8.1 Introduction of dura (sorghum) as an important food grain in East Kordofan


Omdurman
to Al Fasher
Al Fasher
1978
Um Kaddada
En Nahud and Al Obeid
1980
N
20 km
Al Ayit area
West Kordofan
1982
En Nahud and Al Obeid
Al Ayit
Areas from which dura was brought

Source: Field survey (1983)

Figure 8.2 Introduction of dura (sorghum) as an important food grain in East Darfur

above.

It seems that the problem of grain shortage became serious during the early 1980s, and this sparked major government interest.

The problem of *dura* shortage first appeared in the media in 1982. In August 1982 about 50,000 sacks of *dura* were urgently ordered by Darfur regional government. Of these, 35,000 sacks were to be shipped immediately, with 15,000 sacks following at a later date (Al Sahafa Newspaper 1982). Shortly afterward, the minister of administration and regional affairs for Darfur region stated that the region needed a supply of 100,000 sacks of *dura* to alleviate the problem of drought (Al Ayam Newspaper 1982). In September and October 1983 it became very clear to the regional government of Darfur that the problem of *dura* shortage was even greater than it was previously thought. Therefore, the federal minister of finance was approached to increase the amount of the reserved *dura* from 40,000 to 100,000 sacks. Later in November 1983, the regional government of Darfur appealed to the authorities in Khartoum to increase the amount of *dura* to 250,000 sacks (Al Sahafa Newspaper 1984). However, examination of these figures revealed that even the regional government had no idea how many sacks of *dura* were needed; or how many people were affected by drought.

A situation such as this, with poor government intervention would be faced as long as there was no idea by government officials of the number of drought victims. Apart from the field survey which was conducted by Kordofan government in 1984 to assess the number of affected people, no survey was carried out before in any region, so the exact number of drought victims was unknown. Without a correct count of the number of drought affected people, it would be impossible to provide them with sufficient food aid, rations and medical care.

The field survey revealed major problems associated with the use of *dura*. First, because of the physical isolation of Darfur region from the most developed and productive central part of the country (Adams 1975), transportation of the grain was both difficult and expensive. Second, the *dura* shipped from Kosti is of poor quality and consequently, the people are inclined not to use it (Figure 7.1). This government stored food for emergency purposes, but this food was often left to rot and consequently was unusable for feeding animals. Furthermore, prices of government *dura* were high compared to those of commercial *dura*. During the field survey it was found that at Um Kaddada the market price of one sack of the government *dura* was S£34, compared with S£28 for a sack of commercial grain. Consequently, only the less expensive commercial grain sold in the market. This contributed further to the problem of unused government grain supplies.

8.3.2 Response of different levels of government to the 1984 drought

In response to the severe drought of 1984 (e.g., Abd Al Aziz 1984:a; Al Saim 1984; Kaplan 1984; Miller 1985) the federal government relief programmes took a different turn. It was the first time that the federal government had announced Darfur region as a disaster area (Khatir 1984; M.S. 1984). Furthermore, the Sudanese government made international appeals for help to cope with the problems of Ethiopian and Chadian refugees, and later the Sudanese victims of drought (Kaplan 1984; Miller 1985).

The federal government has not established any comprehensive national plan to deal with the problem of drought directly or to co-ordinate the different relief programmes (Miller 1985) despite the fact that many local and international relief programmes are well under way (Al Ayam Newspaper 1984:a; Kaplan 1984; Miller 1985). In the absence of national policy, the responsibility for a drought relief programme was largely undertaken by regional governments (i.e., Kordofan and Darfur). Even during the severe drought of 1984, a relief programme comprised mainly of distribution of *dura*, provision of rations, or transporting of people to relief camps and back to their villages from these camps, became a regional responsibility (e.g., Abd Al Aziz 1984:a, 1984:b; Dobri 1985).

The responsibility of the regional government extended even outside its regional boundary. For example, Kordofan government provided drought victims (all from Kordofan) in the relief camps west of Omdurman with 1200 sacks of *dura* as a first shipment (Abd Al Aziz 1984:a). This, however, does not include the help which was provided by the authorities at

Khartoum to drought victims at Omdurman relief camps (Abd Al Aziz 1984:b).

The plan established by Kordofan regional government in order to assist the estimated one to two million who were seriously affected by the 1984 drought was: (1) providing drought stricken areas with *dura*. The government has shipped 250,000 sacks of *dura* provided by American USAID to these areas. Each community in the drought stricken areas was provided with a six month supply of *dura*. Moreover, each individual in relief camps was provided with a month's supply of *dura* by the time he reached the location of the new settlement (Abd Al Aziz 1984:a); (2) water supply not only was provided to the settlers, but also to the nomads, particularly at *damers*; (3) resettling some drought victims in large villages; and (4) repatriating of some victims to their original villages (Al Ayam Newspaper 1984:c).

The intent of the regional government of Kordofan was to settle drought victims in the front line of the war with desertification in order to plant three million *Hashab* trees immediately. This is part of the green belt project (Gum Arabic belt) which began in 1980, and is aimed ultimately at planting 7.5 million *Hashab* Trees (Abu Baker 1983; Abd Al Aziz 1984:a).

The problem of the 1984 drought in Darfur was alleviated quickly by shipping 150,000 sacks of *dura* to the region in less than three weeks (Abd Al Hafiz 1984). Darfur regional government has an objective to resettle 140,000 drought victims from the northern Darfur population in the southern and south-western Darfur region, mainly in Hofrat Al Nihas and Al Amod Al Akhdur areas (Abu Hag 1984; Abu Zaid 1985; Al Sahafa Newspaper 1984). Eleven sites were chosen for the resettlement. In comparison with the Kordofan relief programme which settled the affected people in the same area (semi-arid), those in Darfur will be moved to the savanna region in the south, which is a totally different environment to the north.

In Darfur, each of the eleven settlements will cost S£7 million (U.S.$2.33 million)(Abu Zaid 1985). Darfur regional government plans to cultivate 350,000 feddan[1] of *dura* next agricultural season (1985/86) in the southern part of the region in order to solve the problem of *dura* shortage whenever it occurs (Abu Hag 1984; Abu Zaid 1985).The resettled people may be working in these schemes. It was the intent of Darfur government to establish these schemes as mechanized schemes similar to those of southern Kordofan and Al Gadarif schemes. Agricultural plots will be given only to qualified farmers (Abu Hag 1984). The regional government wants to satisfy the local demand and to export the surplus. The government is encouraging the youth to replant trees in the northern part of Darfur region as a measure against desertification (Hummad 1984).

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[1] 363300 acres or 147,000 hectares

Both Kordofan and Darfur regional governments face many problems in the execution of their plans. A major problem relates to the lack of finance in maintaining services. With regard to Kordofan, unless fuel and spare parts are continously provided and regular maintenance to water systems maintained, the water systems will be subjected to more frequent break-downs. This aggravates the problem of drought. Darfur regional government faces wider problems. Firstly, there exists the difficulty in securing the amount of money necessary to establish settlement areas, knowing that the prices of building materials will increase. Secondly, if the government of Darfur can secure the money (S£77 million) necessary for settlement, the question arises why it does not improve the situation in the north, because it is more likely that the resettled people will go back there whenever the situation is improved. Thirdly, the question of the relationship between the tribes of the north and the south must be considered. Transported people may well be regarded as intruders in the encumbent tribes' homeland, Fourthly, the question of who is going to be resettled, the farmers or the nomads, or both, must be addressed. Fifthly, as revealed by this study (Chapter 6), one of the major advantages of farming is the possession of land. Attachment to land is one of the main reasons why people remain in drought stricken areas. Therefore, migration should be a voluntary option for people rather than mandatory mass resettlement. The need for this is illustrated by the case of the Zaghawa of northern Darfur who migrated south during the famous Sahelian drought (1969-73), and who came back to their homeland (Abdalla 1984; Tubiana and Tubiana 1977). Sixthly, replanting of trees should be carried out by an organized body similar to the previously mentioned project in Kordofan. If the work is to be carried out by the youth then,in order to ensure that the work will be conducted on a regular basis, incentives and competition must be provided in order to ensure maximum public participation. The field survey revealed that with the exception of the village of Brush, the previous experience of planting green belts around villages in E.Darfur was a failure.

However,the plans of resettling and replanting can be viewed as emergency measures. Plans to cope with drought in the long run were not mentioned by either governments.

8.4 Perception of adjustment:

The government officials were asked what they thought could be done to overcome or lessen the effect of drought. The data presented in Table 8.6 show that most respondents mentioned that trees must not be cut in certain areas, with 34% pointing out the importance of green belts and reforestation. About one quarter suggested irrigation using seasonal streams, 20% mentioned provision of water supply, and 16.0% planning for pasture.

This result suggests that the responses by government officials tended to be more technical, and on a longer term basis. Emphasis was placed on conservation of the physical environment such as green belts, reforestation preventing indiscriminate tree cutting, pasture planning, encouraging cultivation of small plots, and desertification control. These strategies were aimed at a rational utilization of natural resources such as stream irrigation provision of water supply, as well as pasture planning and cultivation of quick maturing crops.

8.5 Effort to develop traditional agriculture

It may be that any effort undertaken by the government in order to develop traditional agriculture in a scientific way, will assist the peasant farmers in their adoption to drought.

Government officials were asked whether any steps had been taken to develop traditional agriculture in the endeavor of teaching drought-coping skills to farmers. The majority of the respondents (58%) answered "Yes." When asked to mention those steps, most

TABLE 8.6

The government officials perception of adjustment

Responses	N	%
Stop cutting trees in certain areas	19	38.0
Green belts and reforestation	17	34.0
Irrigation by making use of seasonal streams	12	24.0
Provision of water supply	10	20.0
Planning for pasture	8	16.0
Cultivation at small plots	6	12.0
Desertification control	4	8.0
Migration	4	8.0
Cultivating quick maturing crops	3	6.0
Pray	3	6.0
Increase animal off-take	1	2.0

* Respondents were allowed to give more than one response

of the respondents pointed out the provision of drought resistant crops. Above one-fifth mentioned loans from the Agricultural Bank (Table 8.7).

Examination of these responses may indicate that they are the main steps needed to develop traditional agriculture as perceived by policy-makers. These steps were undertaken on a very limited scale, to the extent that 42.0% of the government officials were not aware of them.

There is a difference between the government officials' perception of adjustment to drought and what actually has been implemented to try to alleviate the problem of drought. The perception of adjustment to drought suggests the need for long-term drought plans. However, the reality has been the implementation of emergency relief programmes. It appears that the government officials' perceptions of adjustment to drought, and what has actually been done to improve traditional agriculture, are significantly different to the perceptions and adoptions of farmers.

In conclusion, although there is a difference between the government officials' perception of adjustment to drought, and the different levels of adjustment that have been implemented, there is a strong relationship between their perception of drought hazard and adjustment. This is probably related to their high degree of awareness and experience of drought.

8.6 Comparison between resource users and policy makers in terms of perception and adjustment to drought hazard

The following section compares the responses of resource users (farmers and nomads) and policy makers (goverment officials) in terms of their perception and adjustment to drought hazard.

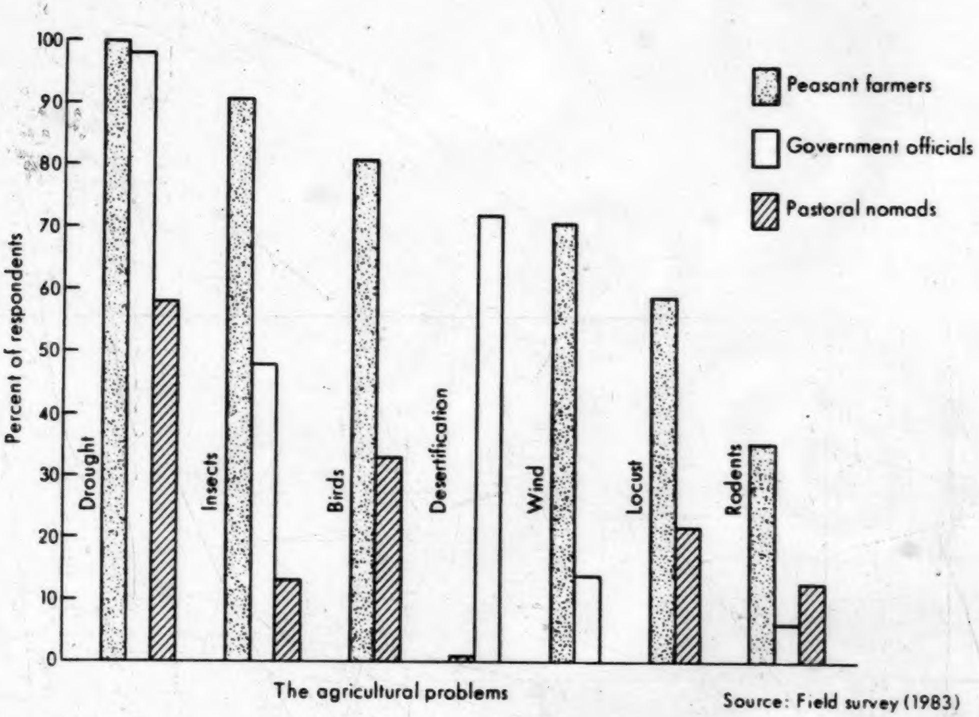
8.6.1 Perception of drought

It was found that both resource users and policy makers are well aware of drought hazard, and place it at the top of the list of agricultural and environmental problems (Figure

TABLE 8.7

Steps that have been undertaken to develop traditional agriculture

Response	N	% of sample	% of responses to the question
Research to provide drought resistant crops	8	16.0	27.6
Loans from the Agricultural Bank	6	12.0	20.7
Introduction of the machanized schemes at the southern part	4	8.0	13.8
Small scale irrigation "Al Khairan area"	3	6.0	10.3
Animal ploughing proved to be better than mech-one.	3	6.0	10.3
Distribution of small quantity of ground nuts	3	6.0	10.3
Planting gum arabic belt	1	2.0	3.4
Establishing of farmers co-operation Socities	1	2.0	3.4
Total	29	58.0	100.0



Source: Field survey (1983)

Figure 8.3 Perception of the main agricultural problems

8.3). Differences were observed between both groups, in regard to the perception of the term drought. The farmers and the nomads perceived it as the lack of rains and the lack of grass respectively while the policy-makers perceived it as a sharp decline in crop yields and animal productivity. Differences also were observed between policy makers and resource users (either farmers or nomads or both) in terms of perception of birds, desertification, and locust problems. In terms of birds hazard, differences were observed between resource users on the one hand, and policy makers on the other hand. While both the farmers and the nomads identified the problem of birds, the government officials failed to perceive it as a problem. In contrast, desertification which was mentioned by 72.0% of the government officials (to them it was the second most important after drought), was mentioned only by the peasant farmers and by none of the nomads. This result suggests that there is a gap with regard to the awareness of the problem of desertification between resource users (farmers and nomads) and policy makers (government officials). It is believed that such a gap could be related to what Saarinen (1982) called "forced awareness". This might be explained by the fact that in recent years the knowledge of desertification at the local level has increased very rapidly through papers (e.g., Ibrahim 1978, 1980, 1983; Rapp 1974; Rapp et al. 1976), conferences (e.g., Al Obeid; Al Fasher 1982, U. of Khartoum 1983), magazines (e.g., At-Tasahhur 1983) and reports (e.g., D.E.C.A.R.P.1975). Due to the bulk of information about desertification, government officials have become more aware of the problem.

Locusts as a problem were not mentioned by the government. However, this fact might explain why the peasant farmers were complaining about the lack of pesticides. The finding that there is a high degree of drought awareness is in agreement with other studies (Ibrahim 1981; Saarinen 1966; Wilken 1982).

All of the farmers and nomads indicated having experience of drought, in comparison to 88% of government officials. The 12% of government officials who had not experienced had only begun their jobs in the study area at the time of the survey.

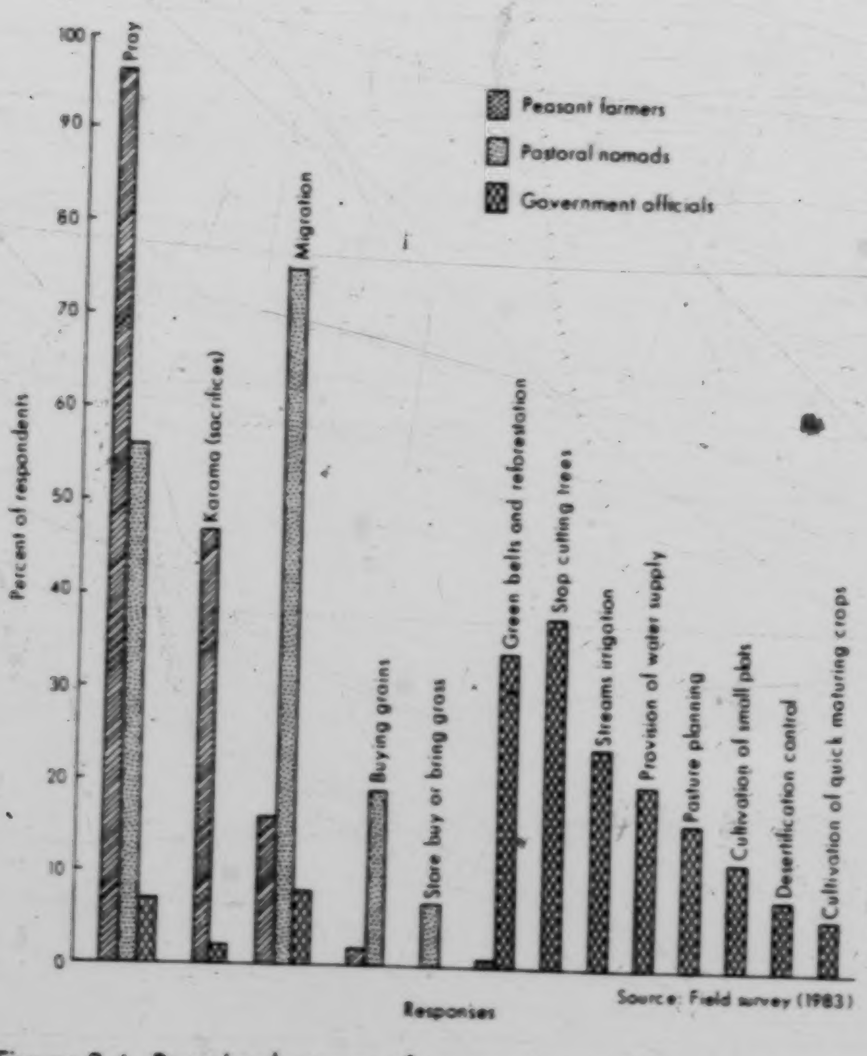
Only a slight difference was observed with regard to the perception of the intensity of drought between the farmers and nomads on the one hand, and the government officials on the other hand (Table 8.8). Almost all resource users perceived the intensity to have increased, whereas 87.8% of policy makers thought that drought had increased in intensity.

These results indicate that there is a general consensus of opinion between the three groups. The majority of respondents believe drought to have increased.

8.6.2 Adjustment to drought

As far as the perception of adjustment to drought hazard is concerned, a marked difference existed between resource users and policy makers (Figure 8.4). While the responses of resource users had religious, social, economic, and environmental dimensions, the policy makers aimed at striking a balance between environmental conservation and the rational utilization of natural resources. Policy makers and resource users agreed upon only two perceived adjustments, "praying" and "migration." Such a gap between the two groups (resources users and policy makers) could be attributed to differences in the levels of education and to the negligence of the traditional sector in favour of modern irrigated agriculture. A contributing factor was the least contact between policy makers and resource users (farmers and nomads).

Another finding relates to the difference between the perceptions of resource users and policy makers in terms of relief aid prior to the 1984 drought (Table 8.9). While resource users thought of the help as a direct emergency relief aid, such as distribution of "free" grain, policy makers thought of it indirectly such as provision of services. It should be mentioned that the regional government of Darfur did distribute some free grain in 1982. The amount of *dura* that was distributed to some households was the equivalent of two-hands full of grain. A condition was that this *dura* be distributed among the poor. However, the criteria to distinguish between the poor and the rich ~~is~~ extremely difficult in a society where drought has equalized the rich with the poor (Abd Al Aziz 1984:a; Field survey 1983).



Source: Field survey (1983)

Figure 8.4 Perceived means of overcoming or lessening the effect of drought hazard by the three groups

TABLE 8.8

Do you think drought increased, decreased or remained the same?

	Peasant farmers		Pastoral nomads		Government officials	
Response	N	%	N	%	N	%
Increased	431	97.3	206	99.0	43	87.8
Decreased	9	2.0	2	1.0	5	10.2
Remained the same	3	0.7	0	0.0	1	2.0
Total	443	100.0	208	100.0	49	100.0

Chi-square = 18.811; d.f. = 4; $p < 0.0009$

TABLE 8.9

Did the government do anything to reduce the effect of drought?

	Peasant farmers		Pastoral nomads		Govt. officials	
Response	N	%	N	%	N	%
Yes	9	2.0	1	0.5	21	42.0
No	435	98.0	207	99.5	29	58.0
Total	444	100.0	208	100.0	50	100.0

Chi-square = 180.961; d.f. = 2; $p < 0.0000$

8.6.3 Ethno-science versus techno-science in relation to diffusion of crops and improvements to traditional agriculture

Ethno-science refers to the traditional forms of perception of and adjustment to drought hazard as practised by local peasant farmers. Techno-sicence refers to the regional government's perception of and adjustment to drought hazard. A comparison between efforts by the peasant farmers and the official government to accept the introduction of new crops and to develop traditional agriculture revealed that the peasant farmers were 14 years ahead of the official effort. While the farmers started to introduce new crops as early as 1965, official government assistance to distribute some samples began as late as the 1980s. On the other hand, 16 varieties of crops were tried by the farmers (Chapter 7), compared with only two varieties distributed formally by Agricultural Research and Farmers' Union. This finding suggests that the peasant farmers possess a high degree of awareness and perception of drought hazard, which has encouraged them to look for new quick-maturing crop varieties which might suit the short and unreliable rainy season. The finding also suggests the importance of local ideas and practices (ethno-science) in understanding the environment. For example, the farmers deliberately brought new crops (Chapter 7). Some of these varieties were given people's names as if the farmers were trying to say "here is something of our own." Most important is that the farmers have developed a considerable knowledge about these varieties as well as the micro-environment which is favourable to them. This knowledge is useful in its own right. In conclusion it may be said that with respect to crop innovation ethno-science was ahead of techno-science, or understanding and adjustment to drought hazard, was ahead of techno-science (official efforts) not only in terms of time (14 years ahead), but also in terms of knowledge. Therefore, any plan of development should consider this fact carefully.

Differences in perception between policy makers and resource users also were observed in relation to the efforts taken to develop traditional agriculture. It was found that certain factors which were of great concern to the farmers were dropped completely by government officials (Table 8.7), such as pesticides, chemical fertilizer, transportation and marketing. This finding suggests, that such differences indicate disagreement between the farmers and government officials in relation to which factor(s) is important in the course of developing traditional agriculture.

It is important to recognize what the farmers did to develop traditional agriculture. Besides the 16 varieties of quick-maturing crops which were introduced by the farmers, farmers' co-operative societies also were established in order to help in marketing. Additionally, the peasant farmers planned to introduce animals into farms by cultivating water melons only for the nomads (Chapter 7). This would be beneficial to both groups, as well as the land. Farmers have introduced pesticides and chemical fertilizer without government interference, and have helped indirectly in the provision of water supply through the on-going programme of self-help. Provision of water supply will help in establishing stability of agricultural returns and the well-being of the peasant farmers, and thus increase agricultural productivity.

All of these steps have been undertaken by the peasant farmers to cope with drought and other hazards such as birds, rodents, and insects. At the same time, these efforts have encouraged the system to be more productive. In this way, peasant farmers have responded to the changes that occurred in their physical environment and in the growing demand for their products because of the increasing population. All of these changes necessitate the modification and development of the agricultural system itself. However, in more than one place throughout this study, it was found that there is a gap between resource users and policy-makers in terms of the perception and allocation of resources. It seems that resource users (peasant farmers) acquired a more complete perception (understanding) of their environment (Chapter 6). Therefore, any attempt to develop traditional agriculture should follow the examples of the peasant farmers.

8.7 Summary

In the absence of a national drought plan, responsibility for a drought relief programme is taken by the regional governments. Only during the 1984 drought were all levels of governments (Federal and regional) involved in alleviating drought problems. Differences were observed between policy-makers (government officials) and resource users (farmers and nomads) with regard to perception of adjustment, assistance during times of drought, and efforts to develop traditional agriculture. It was revealed that resource users acquired a sound knowledge (perception and awareness) of their environment, therefore, their views and ideas must be considered when a drought relief plan is established.

Chapter 9

Summary and Conclusions

9.1 Summary

The primary objective of this study was to investigate methods of adjustment to drought hazard in the semi-arid areas of the Sudan. In addition, there is a set of specific objectives. First, to investigate the differences in perceptions, attitudes and adjustments held by the farmers and the nomads. Secondly, to explore the relationship between perceptions, attitudes, beliefs and adjustment to the drought hazard of farmers and nomads. Thirdly, to compare the differences in perceptions held by policy-makers and resource users. Fourthly, to provide planners and other related professionals with some insight into the adjustment to drought.

It was found that the inhabitants of the semi-arid areas of the Sudan have developed certain methods of adjustment to cope with the drought hazard. Most of these adjustments are strategies that have been developed through a long period of trial and error in order to cope with sporadic drought (Hidore and El Tom 1975). They have been modified, reframed and reconceptualized and adopted as methods of adjustment to the persistent current drought.

These adjustments were adopted, particularly by the farmers and the nomads, in order to minimize the risk from drought and maximize the benefits of the opportunities offered by their environment. At the preparation level both farmers and nomads adjusted to drought by buying grain. In order to make use of the pre-season rains in May and June some farmers cultivate dry "*remal*". Other farmers adjusted by discontinuing this technique to avoid the inadequacy of rains, as well as the harmful effect of birds, rodents and insects on the buried seeds. The perception of adjustment to drought by farmers and nomads tended to be more traditionally and culturally oriented. These include praying, presenting sacrifices, migration and buying grain.

There are specific adjustments adopted by both farmers and nomads. The farmers carry out many on-farm adjustments in order to maximize moisture utilization and minimize moisture waste. These adjustments include cultivation of quick-maturing crops. The time of cultivating the different types of crops is carefully regulated so as to avoid the risks of drought, wind, insects and birds. Mixing of crops, intercropping, replanting, weeding, changing of farm location and farm fragmentation, are adjustments adopted and carried out in a variety of ways in order to reduce lost potential. Seeds dressings were adopted to reduce farm hazards. The farmers have introduced new quick-maturing crops instead of the poorly yielding late-maturing ones. These new crops gained a wide popularity to the extent that about one-quarter of the farmers adopted them. Migration for work to agricultural schemes, towns or nearby villages is the most important adjustment to drought adopted by farmers in case of crop failure.

Migration to the southern more humid areas is the most important adjustment to drought adopted by the nomads. Since the start of the current drought in the mid 1960s, the ***Abbala*** (Camel owners) who used to migrate northward have reversed their migration southward. During recent years they have extended their migration by about 150 km, to where grass and water are plentiful, however, this is a hostile environment for their animals. Ironically, the nomads who were driven south by drought were forced to return northward to their homeland because of the adverse physical environment. The nomads also adjusted to drought by selling some of their animals and buying grain.

The farmers and nomads have diversified their adjustments. The farmers keep animals and some nomads cultivate crops. The farmers supplement their on-farm with off-farm income. Interaction of adjustments between the two groups is inevitable, and it was always directed towards the betterment of both groups.

Most if not all of these adjustments were instituted by the people themselves without any help from the government. People viewed them as successful, and with the exception of the present drought they have been able to cope with drought without outside help. Members of the family or tribe always help each other. The experience of the 1984 drought has revealed that there is no long or short-term plans for coping with drought. Regional as well as federal government has helped drought victims, but the proportion of those who were helped was less than one-quarter of those who were actually affected by drought.

9.2 Findings pertinent to specific objectives

First objective: Significant differences were found between the peasant farmers and the pastoral nomads with regard to the perception of the term "drought". While the vast majority of the farmers perceived drought as a lack of rainfall, the nomads perceived it as the lack of grass. Differences were also observed between both groups in terms of identifying signs of drought. More nomads than farmers were able to identify signs of drought. On the other hand, differences were not observed between the two groups in relation to the perception of drought intensity, awareness and the experience. Both farmers and nomads perceived drought to have increased in recent years. Similarly, all of them are aware of and have experienced drought. Differences have been noticed between the two groups with reference to the perception of adjustment. Differences were also observed with regard to attitude change towards the environment between the two groups. While more than half of the farmers changed their attitude towards the environment and wanted to raise animals instead of farming, the vast majority of the nomads wanted to carry on nomadic life and increase their herds' numbers. On the other hand, differences were not noticed between the two groups in relation to their attitude towards adjustment and the majority of them were happy about the adjustment they had adopted. Differences were also observed with reference to adjustments to the drought hazard since their specific adjustments were different.

Second objective: With regard to the relationship between perceptions, attitudes, beliefs and adjustment to drought hazard by farmers and nomads, it was found that there is a strong relationship between people's cognitive processes and adjustment to drought. The perceived short rainy season has encouraged people to seek ways to cope with it. They include the introduction of quick-maturing crops, better farm management, purchase of grain, migration to work and to areas where water and grass are plentiful, and finally sale of animals. As far as attitude is concerned, it was found that people have developed a positive attitude towards adjustment and the newly introduced quick-maturing crops. Such a positive attitude has encouraged the people to adopt the same adjustment in future droughts and to cultivate the newly introduced crops. On the other hand, negative attitudes discourage farmers from cultivating poorly yielding late-maturing crops. It was also found that people's beliefs affect their adjustment to drought both positively and negatively. The Islamic beliefs have also had a profound effect on people's attitude towards their environment, signs of drought and their perception of adjustment by instilling optimism about the rainy season through their faith in *Allah* (S.T.). In view of the above discussion the findings of this study suggest that there is a strong relationship between perceptions, attitudes, beliefs and adjustment to drought hazard. In other words cognitive processes are found to be important in the course of human decision-making and spatial behaviour, in this case in the context of adjustment to drought hazard. Moreover, perception, attitude and beliefs can be used as predictors of behaviour. However, the findings of this study are not only significant for adjustment to drought but also for human spatial behaviour in general. The results obtained can be transfered to other studies of natural hazards, resource use and conservation, and surrogate fields such as consumer spatial behaviour and residential mobility.

Third objective: Comparison of the differences in the perceptions held by policy-makers and resource users revealed that there are marked differences between the two groups. Differences were observed with regard to the perception, intensity and experience of drought. Differences have also been noticed between them in terms of the perception of adjustment. While the resource users' perception of adjustment tended to be more traditional, the policy-makers' perception of adjustment is viewed as a scientific plan aimed at striking a balance between utilization of natural resources and ecological conservation. With reference to drought awareness no difference is observed. Both groups held a high degree of drought awareness.

Fourth objective: the findings of this study provide planners and other related professionals with some insight into the adjustment to drought. This study emphasizes the importance of field surveys as a primary source of data which helps in the formulation of sound plans, since it is based on people's perception and response to their new environment. Furthermore, the findings fill a large gap in the literature on adjustment to drought hazard by both farmers and nomads in the third world (Chapter 1). This study is particularly important because the data comes from one of the areas most affected by the current African drought.

In conclusion, the study has both practical and theoretical implications. In practical terms the study revealed that despite the increase in the population of the semi-arid areas (Kates et al. 1977, Sudanese Census 1983), and continuous land deterioration (DECARP 1976; Mabbutt 1984) that resulted in progressive environmental changes, the inhabitants of these areas were able to adjust consistently and steadily to these changes. Furthermore, when the environmental changes were aggressive, the people were, in turn, aggressive in making adjustments. The role of policy-makers in response to drought hazard is confined to emergency relief aid.

In terms of theoretical implications the results of the study suggest that people's adjustment to drought is based on awareness and accurate perception of the drought hazard. This stems from the fact that the inhabitants of the semi-arid areas have intense personal experience of drought, especially during the last two decades.

As a final comment in relation to the research approach this study illustrates that adjustment to drought hazard is not solely of an economic nature. Adjustment to drought based merely on economic factors has proved to be a failure. Hackett (1984:20) reported that:

> Many donors are frustrated with the apparent lack of progress in Africa despite billions of dollars in past aid. Agricultural failures are often cited - Africa's food imports have tripled during the last decade.

On the other hand, this study demonstrated that perception and behaviour provide a more useful approach to the problem of drought in Africa, because it gives a more accurate picture of people's feelings about, and adjustment to, their environment. While economic approaches should not be ignored, it has to be preceeded by perceptual and behavioural studies.

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Appendix 1

Questionnaire (1) Peasant Farmers

I would like to ask you some questions about your agricultural operation:

1. How long have you been farming in this area? ....
(If less than 3 years) where did you farm before? ....
....

2. Are you owner (   ) Partner (   ) or manager (   ) of this farm?

3. When do you prepare yourself for a new agricultural Season?
....

4. Have you changed the nature of your operations during the last ten years? Yes (   ) No (   ). (If yes) How?
....
....

5. Do you use hired Laborers? Yes .... No ..... (If yes) Are they full-time ..... or Part-time .... (If part-time) when do you use them? ....

6. What are the advantage of farming in this area? ....
....
....
....

7. What are the major natural problems of farming in this area?
- Drought
- Plant disease
- Lack of water supply
- Insects
- Flood
- Other ....
- Wind
- Too much heat

8. What is the highest single cost on your Farm? ....
....

I would like to ask you some questions about drought:

9. Have you experienced any drought in this farm ?
Yes ..... No ..... (If yes) in which year(s)? ....
.............................(If no go to question 22)

10. When was the last drought that you have experienced in this Farm? ....

11. What was the worse thing about drought in that year? ......
....
....
....

12. What does the word drought mean to you? ....
....

13. Are there any signs or ways of knowing when a drought will come again? Yes ..... No ...... Don't know ....
(If yes) Explain ....
....
....

14. Do you think there will be drought this year? Yes ....
No ...... Don't know ...... Other (God knows) ....
(If yes or No) Explain ....
....
....

15. How do you prepare yourself for drought? ....
....

Now let us talk a little bit about the last drought you have mentioned?

16. When did you decide that you were in drought? ....
....

17. What did you do then? ....

18. If a warning were to be given that a drought is coming this year, would you do the same or something different? Do the same .... Do something different ....
or accepting any kind of work wherever available ....
or moving out of this area ....

19. What do you think could be done to overcome or lessen the effect of drought?..
....
....

20. From your experience with drought ,how often does drought occur? Evefy...........year(s).

21. Do you believe that during recent years the number of droughts has increased..........or decreased........or remained the same?
...........Explain...
....
....

Now let us talk a little about crops

22. What crops are you growing?
1- .... 2- .... 3- .... 4- ....
5- .... 6- .... 7- .... 8- ....

23. How many mukhamas of each crop did you cultivate last year?
1- .... 2- .... 3- .... 4- ....
5- .... 6- .... 7- .... 8- ....

24. What was your crop yield last year? (in sacks)
1- .... 2- .... 3- .... 4- ....
5- .... 6- .... 7- .... 8- ....

25. Why are you growing these crops and not some other crops?
....
....

26. What would you expect your crop yields would be if you were having a good farming year? (in sacks)
1- .... 2- .... 3- .... 4- ....
5- .... 6- .... 7- .... 8- ....

27. What is your annual consumption of :
- Sorghum .... Sacks - Millet .... Sacks

28. If you have enough money to invest, what thing(s) would you like to invest in?
1- .... 2- .... 3- .... 4- ....
5- .... 6- .... 7- .... 8- ....
Why? ....
....

29. Where do you sell your crops? ....

30. Do you have any problem with crop marketing? Yes ..... No ..
(If yes) what problem ?.....................................
....

A- Any problem with crop storage? Yes .... No.......(If yes)
what problem ?..
- where do you usually store your crops? ....

B- Any problem with crop transportation? Yes ...... No......
(If yes) what problem? ....
....

31. Within recent years have you introduced any new crop?
Yes .... No .... (If yes) which crop? ....
Why? ....
....
.... (If No go to Q.39)

32. When did you start cultivating this crop? Year ....

33. Who brought it to this area?............................
From where? ....

34. Is it a substitute for an old one? Yes ...... No ....
(If yes) which one? Crop....................................

35. How much do you like the new one? I like it ....
Half-half .... Don't like it ....(If like it or don't like it) Why?..

36. How much do you like the old one? I like it ....
Half-half .... Don't like it .... Why? .....
....

37. What was your crop yield in the last year you cultivated the old one? ...... Sacks, area .... Mukh.

38. Would you recommend the new one for other farmers?
yes .... No .... Explain ....
....
....

Now let us talk a little bit about animals:

39. Do you keep some animals? Yes ...... No ...... (If yes) what sort of animals do you keep? Camels .... Cattle .... Sheep ...... Goats .... Donkeys .... (If no go to Quest. 44).

40. What did you do with your animals in times of drought?
- Keep them
- Sell part of them
- Sell most of them
- Other ....

41. (If selling is mentioned) Why? ....
....

42. Where do you sell them? ....

43. How many do you lose every year?
- Selling .... Disease .... Theft ....
- Drought .... Other ....

Now let us talk about the type of help you get during drought times:

44. Did the government do anything to reduce the effect of drought?
Yes .... No .... (If yes) What?.......................
....

45. Did you receive any kind of help during drought times?
Yes ..... No ...... (If yes) From whom? ....
.... What kind of help? ....
....
....

Personal Questions:

46. When were you born? ....

47. Education ....

48. Size of family ....

49. Is more than 25% of your gross income drived from off-farm source? Yes ...... No ...... (If yes) From what? ....
....

Name .... Site of Farm ....
....

50. Do you have any point or general remarks you would like to make about drought?
....
....
....
....
....
....
....
....
....

Appendix 2

Questionnairs (II) The Pastoral Nomads

I would like to ask you some questions about drought:

1. Have you experienced any drought? Yes .... No....(If yes)
When was the last one? .... (If No go to Quest. 16).

2. How many years have you experienced drought?

3. Where do you think the area where severe drought are frequent?
....

4. Have you been there? Yes ...... No ...... (If yes) When? ......

5. Have you lost any of your animals in the last 2 years? Yes .....
No ..... (If Yes) How many? Because of :
- Drought .... - Disease ....
- Theft .... - Other ....

6. What does the word drought mean to you? ....
....

7. Are there any signs or ways of knowing when a drought will come
again? Yes .... No .... Don't know .... (If yes)
Explain ....
....
....

8. Do you think there will be drought this year? Yes ..... No .....
God knows ....(If yes or no) Why?..............................
....
....

9. How do you prepare yourself for drought? ....
....

Now let us talk a little bit about the last drought:

10. When did you know you were in drought? ....
....

11. What did you do? ....
....

12. What do you think could be done to overcome or lessen the effect of drought ? ....

....

....

13. Do you think the number of droughts has increased ...., or decreased .... or remained the same .... during recent years ?

Explain ....

....

....

14. Did you receive any kind of help in times of severe droughts ?

Yes ...... No ...... (If yes) What kind of help ? ....

....

From whom ? ....

15. Did the government do anything to help reduce the effect of drought ? Yes ...... No .... (If yes) What kind of help ?

....

.... When ? ....

General information:

16. (A) Where did you spend the summer?

(B) Where did you come from ? ....

17. Is this the first time to come here ? Yes ..... No ....

18. What are the major reasons that led you come here ?

- Water supply
- Grass
- Access to market
- Availability of work
- Vet. clinic services
- Other ....

19. Are you happy with what you have found here ? Yes .... No ....

(If no) Why? ....

....

20. Did you come alone or with family ? Alone ...... With family ....

21. How long do you plan to stay here ? ....

22. Where do you have your grazing ground ? ....

23. Where do you usually spend the dry season ? ....

....

24. Are you willing to stay here permanently....or go back to your grazing ground......or go elsewhere?.........................

(If elsewhere) Where?...

25. What is the greatest problem that you face here?.............

....

26. What kind and number of animals do you keep?

Camels.......Cattle.....Sheep.......Goats.....Donkeys............

27. What did you do with your animals during the last drought? ....

....

....

28. How many animals did you sell last year? ....

29. What kind of animals do you sell?

- Young male
- Young female
- Other ....
- Old male
- Old female
- ....

30. If you have enough money to invest would you?

- Buy more animals
- Work as business man
- Cultivate (more) crops
- Other ....

Now let us talk a little bit about farming:

31. Do practice any type of cultivation? Yes .... No .... (if No go to Quest. 36) (If yes) which crops 1. ....
2. .... 3. .... 4. .... 5. ....
Size of Farm .... mukh. Where? ....

32. What was your average yield last year? (in sacks) 1. ....
2. .... 3. .... 4. .... 5. ....

33. What was your average yield in good farming years? (in sacks)
1. .... 2. .... 3. .... 4. .... 5. ....

34. What are the problems of farming in the area where you farm?

- Drought
- Wind
- Plant disease
- Flood
- Animal damage
- Other ....

35. Do you buy grains from settlers? Yes .... No .... (If yes)
How many sacks for 1982 .... 1981 .... 1980 ....
1979 .... 1978 .... from where? ....
....(If no go to Q39)

36. Are these grains for family consumption ......, Animals ....
or farming .... ?

37. Are these grains easy to get? yes ...... No .... (If No)
Why? ....
....

38. What were the prices for one sack of (sorghum - millet) in
1982 ...... 1981 .... 1980 .... 1979 .... 1978 .....

Let us talk a little bit about settlement:

39. How would you rate "Girah Al Sarha"?
Successful .... Half-half .... Not successful ....
Don't know ......(In case of successful or not successful) Explain
....

40. Do you agree or disagree with settlement? Agree ....Don't agree ...
(If agree) Where? .... Explain ......
....
....

Some Personal Questions:

41. Level of education ....
42. Would you like sending your children to school? Yes ....
No. .... Explain ....
....
....

43. Were there any quarrels between you and other herdsmen?
Yes ...... No ....

44. Were there any quarrels between you and settlers ?Yes.......No....
(If yes) How did you solve the problem ?........................
....
....

45. What is your annual income? ....

Name .... Tribe ....

Age .... Site of interview ....

Any further comment :

....

....

....

....

....

....

....

....

....

Appendix 3

Questionnaire (111) Government Officials

PART ONE

Name .... Education ....

Age .... Sex .... Site of Interview ....

PART TWO

Iwould like to ask you some questions about the problem of this area and drought in particular:

1. What do you think are the main problems of this area ?

* Drought
* Transportation
* Theft
* Desertification
* Animal disease
* Crop marketing
* Insects
* Water supply
* High prices
* Other (specify) ....

2. What are the main agricultural problems ?

* Drought
* Wind
* Crop damage by animals
* Insects
* Floods
* Desertification
* Plant disease
* Other ....
....

3. (If drought is mentioned) During your stay here as an authority have there been any drought ? Yes .... No ...... (If yes) When ?
....

4. Do local authorities provide any help to the local people in drought prone areas ? Yes .... No .... (If yes) What kind of help that has been given ? ....
....
In which year(s) ? ....

5. What critically shows that this area is experiencing a true drought condition ? ....
....

6. Do you think drought during recent years has increased .... or decreased .... , or remained the same ...., or don't know .... (If not don't know) Explain ....
....
....

7. What could be done to overcome or lessen the effect of drought?
....
....

8. Are there any steps or projects that have been undertaken to develop traditional agriculture in this area? Yes....No.....
(if yes) What has been done?..............................
....
....
....

Now let us talk a little bit about the nomads.

9. What are the problems that face the nomads in this area?
- * Shortage of water supply
- * Lack of grass
- * Illnesses
- * Thefts
- * Lack of social services
- * Tribal conflicts
- * Animal marketing
- * Desertification
- * Other (specify) ....

10. How do you judge the problem of nomad's settlement?
Agree .... Don't agree .... Don't Know ....
Explain (if agree or don't agree) ....
....
....

11. Are there any steps or actions that have been undertaken to develop nomadic way of life? Yes ..... No ...... Explain ......
....
....
....

Any further comment(s)? ....
....
....
....
....
....
....
....

Appendix 4

The sample sites of the peasant farmers in E.Kordofan

#of villages(sample sites)	#of cases	I.D.
1- Al Adousa	11	1 - 11
2- Al Bahriya	13	12- 24
3- Um Dam	21	25- 45
4- Kagarat	13	46- 58
5- Zagalona	10	59- 68
6- Um Boyaida	7	69- 75
7- Al Khun	7	76- 82
8--Shurri	6	83- 88
9- Magrur	10	89- 98
10-Namla	10	99- 108
11-Al Birasa	17	109-125
12-Bashom	13	126-138
13-Al Humra	9	139-147
14-Bit Goda	13	148-160
15-Yasin	10	161-170
16-Al Gafil	10	171-180
17-Shubola	12	181-192
18-Abu Gurein	18	193-210
19-Kadada	9	211-219
20-Tafantara	11	220-230
21-Wad Sabil	8	231-238
22-Fangoga	10	239-248
23-Um Gannas	9	249-257
24-Abu Saad	9	258-266
Total	266	266

Appendix 5

The sample sites of the peassant farmers in E.Darfur

#of villages(sample sites)	#of cases	I.D.
1 - Al Arais	9	267-275
2 - Abyad	7	276-282
3 - Tubluk	9	283-291
4 - Um Talateen	10	292-301
5 - Brush	10	302-311
6 - Al Hilla	10	312-321
7 - Sunnata	10	322-331
8 - Um Gafala	10	332-341
9 - Abu Himara	12	342-353
10- Al Rutrut	12	354-365
11- Um Hosh	8	366-373
12- Gabir	12	374-385
13- Tom Bushara	11	386-396
14- Karoya	12	397-408
15- Towaisha	9	409-417
16- Um Saauna	12	418-429
17- Huskanita	15	430-444
Total	178	444

Appendix 6

Pastoral nomads sample sites of E.Kordofan and E.Darfur

Pastoral nomads sample sites of E.Kordofan

#	Sample site	#of cases	I.D.
1-	Bahryia	5	1 - 5
2-	Um Dam	17	6 - 22
3-	Kagarat	14	23- 36
4-	Zariba	8	37- 44
5-	Um Simama	32	45- 76
6-	Magrour	4	77- 80
7-	Shurri	5	81- 85
8-	Al Birasa	7	86- 92
9-	Bit Goda	6	93- 98
10--	Abu Himara	7	99- 105
11-	Shubula	7	106-112
	Pastoral nomads sample sites of E.Darfur		
12-	Abyad	15	113-127
13-	Tubluk	11	128-138
14-	Um Kaddada	15	139-153
15-	Al Hilla	11	154-164
16-	Um Gafala	12	165-176
17-	Um Hosh	14	177-190
18-	10	10	191-200
19-	Huskanita	8	201-208
Total		208	208

Appendix 7

Government officials sample sites for Kordofan and Darfur regions

Region	sample site	# of cases	I.D.
Kordofan	Al Obeid	22	1 - 22
	Um Rowaba	6	23- 28
	Er Rahad	2	29- 30
	Abu Saad	1	31
Darfur	Al Fasher	11	32- 42
	Um Kaddada	5	43- 47
	Al Ayit	3	48- 50
Total	7	50	50

Appendix 8

VILLAGE OSERVATION SHEET

Site of village * sand (Qoz) .... * Clay ....

Population size ....

Physical Environment:

- * Types of vegetation ....
- * Geomorphology ....
- * Desertification ....
- * Source of Water supply

	Location	Condition
* Spring	....	....
* Subsurface well	....	....
* Borehole	....	....

* Any problem with water supply ....
....
....

Education:

Pre-elementary .... * Elementary .... J.H. ....

S.H. ....

Health:

- * Clinics (Human) .... (Animal) ....
- * Major illness ....
- * Malnutrition: High .... Mid .... Low ....
- * Overall health condition: Good .... Bad ....

Transportation:

- * To nearest city ....
- * To other part of the country ....

Economy:

- * Market: Daily .... Weekly ....

Crop storage ....

Prices of crops for the last 5 years (per sack)

Crop	1982	1981	1980	1979	1978
Millet	......	......	....	......	....
Sorghum	......	......	......	......	....
Sesame	......	......	....	......	....
Groundnut	......	......	....	......	....

Any light industries (e.g. Oil mills)

....

....

....

Signs of modernization and innovations in terms of :

- Housing ....
  ....
- Market stores ....
  ....
- Projects ....
  ....

Records of :

- Crop sale ....
- Animal sale ....
- Past Famine ....

Site of observation: ....

....

Any other observation or comment ....

....

....

....

....

....

....

....

....

Appendix 9

The relationship between the introduction of new crop and education,age,mobility,familysize and farm advantage

Education

The total sample of the study area

```
                  RECENT
         COUNT   |
         ROW PCT |YES       NO          ROW
         COL PCT |                      TOTAL
         TOT PCT |        1|        2|
EDUCATA  --------+---------+---------+
                1|     89  |    253  |   342
  Illiterate     |   26.0  |   74.0  |  77.0
                 |   79.5  |   76.2  |
                 |   20.0  |   57.0  |
                 +---------+---------+
                2|     23  |     79  |   102
  Literate       |   22.5  |   77.5  |  23.0
                 |   20.5  |   23.8  |
                 |    5.2  |   17.8  |
                 +---------+---------+
          COLUMN     112       332       444
          TOTAL     25.2      74.8     100.0

CHI-SQUARE   D.F.      SIGNIFICANCE
----------   ----      ------------

  0.33548      1         0.5624
  0.50281      1         0.4783

 MIN E.F.     CELLS WITH E.F.< 5
 --------     ------------------

  25.730           NONE
 ( BEFORE YATES CORRECTION )
```

E.Kordofan sample

```
                  RECENT
         COUNT   |
         ROW PCT |YES       NO          ROW
         COL PCT |                      TOTAL
         TOT PCT |        1|        2|
EDUCATA  --------+---------+---------+
                1|     75  |    142  |   217
  Illiterate     |   34.6  |   65.4  |  81.6
                 |   82.4  |   81.1  |
                 |   28.2  |   53.4  |
                 +---------+---------+
                2|     16  |     33  |    49
  Literate       |   32.7  |   67.3  |  18.4
                 |   17.6  |   18.9  |
                 |    6.0  |   12.4  |
                 +---------+---------+
          COLUMN      91       175       266
          TOTAL     34.2      65.8     100.0

CHI-SQUARE   D.F.      SIGNIFICANCE
----------   ----      ------------

  0.00770      1         0.9301
  0.06474      1         0.7992

 MIN E.F.     CELLS WITH E.F.< 5
 --------     ------------------

  16.763           NONE
 ( BEFORE YATES CORRECTION )
```

E.Darfur sample

```
                  RECENT
         COUNT   |
         ROW PCT |YES       NO          ROW
         COL PCT |                      TOTAL
         TOT PCT |        1|        2|
EDUCATA  --------+---------+---------+
                1|     14  |    111  |   125
  Illiterate     |   11.2  |   88.8  |  70.2
                 |   66.7  |   70.7  |
                 |    7.9  |   62.4  |
                 +---------+---------+
                2|      7  |     46  |    53
  Literate       |   13.2  |   86.8  |  29.8
                 |   33.3  |   29.3  |
                 |    3.9  |   25.8  |
                 +---------+---------+
          COLUMN      21       157       178
          TOTAL     11.8      88.2     100.0

CHI-SQUARE   D.F.      SIGNIFICANCE
----------   ----      ------------

  0.01570      1         0.9003
  0.14415      1         0.7042

 MIN E.F.     CELLS WITH E.F.< 5
 --------     ------------------

   6.253           NONE
 ( BEFORE YATES CORRECTION )
```

Age

The total sample of the study area

```
                  RECENT
         COUNT   |
         ROW PCT |YES       NO          ROW
         COL PCT |                      TOTAL
         TOT PCT |        1|        2|
AGE      --------+---------+---------+
                1|     17  |     61  |    78
  < 30           |   21.8  |   78.2  |  17.6
                 |   15.2  |   18.4  |
                 |    3.8  |   13.7  |
                 +---------+---------+
                2|     31  |    106  |   137
  31 - 40        |   22.6  |   77.4  |  30.9
                 |   27.7  |   31.9  |
                 |    7.0  |   23.9  |
                 +---------+---------+
                3|     29  |     68  |    97
  41 - 50        |   29.9  |   70.1  |  21.8
                 |   25.9  |   20.5  |
                 |    6.5  |   15.3  |
                 +---------+---------+
                4|     35  |     97  |   132
  51 & Over      |   26.5  |   73.5  |  29.7
                 |   31.3  |   29.2  |
                 |    7.9  |   21.8  |
                 +---------+---------+
          COLUMN     112       332       444
          TOTAL     25.2      74.8     100.0

CHI-SQUARE   D.F.      SIGNIFICANCE
----------   ----      ------------

  2.01545      3         0.5690
 MIN E.F.     CELLS WITH E.F.< 5
 --------     ------------------

  19.676           NONE
```

E.Kordofan sample

```
                  RECENT
         COUNT   |
         ROW PCT |YES       NO          ROW
         COL PCT |                      TOTAL
         TOT PCT |        1|        2|
AGE      --------+---------+---------+
                1|     16  |     45  |    61
  < 30           |   26.2  |   73.8  |  22.9
                 |   17.6  |   25.7  |
                 |    6.0  |   16.9  |
                 +---------+---------+
                2|     23  |     56  |    79
  31 - 40        |   29.1  |   70.9  |  29.7
                 |   25.3  |   32.0  |
                 |    8.6  |   21.1  |
                 +---------+---------+
                3|     24  |     29  |    53
  41 - 50        |   45.3  |   54.7  |  19.9
                 |   26.4  |   16.6  |
                 |    9.0  |   10.9  |
                 +---------+---------+
                4|     28  |     45  |    73
  51 & Over      |   38.4  |   61.6  |  27.4
                 |   30.8  |   25.7  |
                 |   10.5  |   16.9  |
                 +---------+---------+
          COLUMN      91       175       266
          TOTAL     34.2      65.8     100.0

CHI-SQUARE   D.F.      SIGNIFICANCE
----------   ----      ------------

  6.08254      3         0.1077
 MIN E.F.     CELLS WITH E.F.< 5
 --------     ------------------

  18.132           NONE
```

E.Darfur sample

```
                  RECENT
         COUNT   |
         ROW PCT |YES       NO          ROW
         COL PCT |                      TOTAL
         TOT PCT |        1|        2|
AGE      --------+---------+---------+
                1|      1  |     16  |    17
  < 30           |    5.9  |   94.1  |   9.6
                 |    4.8  |   10.2  |
                 |     .6  |    9.0  |
                 +---------+---------+
                2|      8  |     50  |    58
  31 - 40        |   13.8  |   86.2  |  32.6
                 |   38.1  |   31.8  |
                 |    4.5  |   28.1  |
                 +---------+---------+
                3|      5  |     39  |    44
  41 - 50        |   11.4  |   88.6  |  24.7
                 |   23.8  |   24.8  |
                 |    2.8  |   21.9  |
                 +---------+---------+
                4|      7  |     52  |    59
  51 & Over      |   11.9  |   88.1  |  33.1
                 |   33.3  |   33.1  |
                 |    3.9  |   29.2  |
                 +---------+---------+
          COLUMN      21       157       178
          TOTAL     11.8      88.2     100.0

CHI-SQUARE   D.F.      SIGNIFICANCE
----------   ----      ------------

  0.80180      3         0.8490
 MIN E.F.     CELLS WITH E.F.< 5
 --------     ------------------

   2.006      1 OF     8 ( 12.5%)
```

Mobility

The total sample of the study area

```
                     RECENT
            COUNT   |
            ROW PCT |Yes        No          ROW
            COL PCT |                       TOTAL
            TOT PCT |        1|        2|
ACTDONE     --------+---------+---------+
                  1 |      45 |     163 |     208
  Migrated          |    21.6 |    78.4 |    46.8
                    |    40.2 |    49.1 |
                    |    10.1 |    36.7 |
                    +---------+---------+
                  2 |      67 |     169 |     236
  Stayed at Place   |    28.4 |    71.6 |    53.2
                    |    59.8 |    50.9 |
                    |    15.1 |    38.1 |
                    +---------+---------+
             COLUMN       112       332       444
              TOTAL      25.2      74.8     100.0

 CHI-SQUARE    D.F.      SIGNIFICANCE
 ----------    ----      ------------

   2.33859       1          0.1270
   2.67473       1          0.1020

   MIN E.F.      CELLS WITH E.F.< 5
   --------      ------------------

    52.468          NONE
 ( BEFORE YATES CORRECTION )
```

E.Kordofan sample

```
                     RECENT
            COUNT   |
            ROW PCT |Yes        No          ROW
            COL PCT |                       TOTAL
            TOT PCT |        1|        2|
ACTDONE     --------+---------+---------+
                  1 |      41 |      86 |     127
  Migrated          |    32.3 |    67.7 |    47.7
                    |    45.1 |    49.1 |
                    |    15.4 |    32.3 |
                    +---------+---------+
                  2 |      50 |      89 |     139
  Stayed at Place   |    36.0 |    64.0 |    52.3
                    |    54.9 |    50.9 |
                    |    18.8 |    33.5 |
                    +---------+---------+
             COLUMN        91       175       266
              TOTAL      34.2      65.8     100.0

 CHI-SQUARE    D.F.      SIGNIFICANCE
 ----------    ----      ------------

   0.25389       1          0.6143
   0.40100       1          0.5266

   MIN E.F.      CELLS WITH E.F.< 5
   --------      ------------------

    43.447          NONE
 ( BEFORE YATES CORRECTION )
```

E.Darfur sample

```
                     RECENT
            COUNT   |
            ROW PCT |Yes        No          ROW
            COL PCT |                       TOTAL
            TOT PCT |        1|        2|
ACTDONE     --------+---------+---------+
                  1 |       4 |      77 |      81
  Migrated          |     4.9 |    95.1 |    45.5
                    |    19.0 |    49.0 |
                    |     2.2 |    43.3 |
                    +---------+---------+
                  2 |      17 |      80 |      97
  Stayed at Place   |    17.5 |    82.5 |    54.5
                    |    81.0 |    51.0 |
                    |     9.6 |    44.9 |
                    +---------+---------+
             COLUMN        21       157       178
              TOTAL      11.8      88.2     100.0

 CHI-SQUARE    D.F.      SIGNIFICANCE
 ----------    ----      ------------

   5.56982       1          0.0183
   6.73104       1          0.0095

   MIN E.F.      CELLS WITH E.F.< 5
   --------      ------------------

     9.556          NONE
 ( BEFORE YATES CORRECTION )
```

Family size

The total sample of the study area

```
                     RECENT
            COUNT   |
            ROW PCT |Yes        No          ROW
            COL PCT |                       TOTAL
            TOT PCT |        1|        2|
MILYSIZ     --------+---------+---------+
                  1 |       3 |      22 |      25
  1 - 3             |    12.0 |    88.0 |     5.6
                    |     2.7 |     6.6 |
                    |      .7 |     5.0 |
                    +---------+---------+
                  2 |      31 |     114 |     145
  4 - 6             |    21.4 |    78.6 |    32.7
                    |    27.7 |    34.3 |
                    |     7.0 |    25.7 |
                    +---------+---------+
                  3 |      35 |     104 |     139
  7 - 9             |    25.2 |    74.8 |    31.3
                    |    31.3 |    31.3 |
                    |     7.9 |    23.4 |
                    +---------+---------+
                  4 |      43 |      92 |     135
  10 or More        |    31.9 |    68.1 |    30.4
                    |    38.4 |    27.7 |
                    |     9.7 |    20.7 |
                    +---------+---------+
             COLUMN       112       332       444
              TOTAL      25.2      74.8     100.0

 CHI-SQUARE    D.F.      SIGNIFICANCE
 ----------    ----      ------------

   6.58831       3          0.0863

   MIN E.F.      CELLS WITH E.F.< 5
   --------      ------------------

     6.306          NONE
```

E.Kordofan sample

```
                     RECENT
            COUNT   |
            ROW PCT |Yes        No          ROW
            COL PCT |                       TOTAL
            TOT PCT |        1|        2|
FMILYSIZ    --------+---------+---------+
                  1 |       3 |      14 |      17
  1 - 3             |    17.6 |    82.4 |     6.4
                    |     3.3 |     8.0 |
                    |     1.1 |     5.3 |
                    +---------+---------+
                  2 |      27 |      78 |     105
  4 - 6             |    25.7 |    74.3 |    39.5
                    |    29.7 |    44.6 |
                    |    10.2 |    29.3 |
                    +---------+---------+
                  3 |      29 |      55 |      84
  7 - 9             |    34.5 |    65.5 |    31.6
                    |    31.9 |    31.4 |
                    |    10.9 |    20.7 |
                    +---------+---------+
                  4 |      32 |      28 |      60
  10 or More        |    53.3 |    46.7 |    22.6
                    |    35.2 |    16.0 |
                    |    12.0 |    10.5 |
                    +---------+---------+
             COLUMN        91       175       266
              TOTAL      34.2      65.8     100.0

 CHI-SQUARE    D.F.      SIGNIFICANCE
 ----------    ----      ------------

  15.18205       3          0.0017

   MIN E.F.      CELLS WITH E.F.< 5
   --------      ------------------

     5.816          NONE
```

E.Darfur sample

```
                     RECENT
            COUNT   |
            ROW PCT |Yes        No          ROW
            COL PCT |                       TOTAL
            TOT PCT |        1|        2|
FMILYSIZ    --------+---------+---------+
                  1 |         |       8 |       8
  1 - 3             |         |   100.0 |     4.5
                    |         |     5.1 |
                    |         |     4.5 |
                    +---------+---------+
                  2 |       4 |      36 |      40
  4 - 6             |    10.0 |    90.0 |    22.5
                    |    19.0 |    22.9 |
                    |     2.2 |    20.2 |
                    +---------+---------+
                  3 |       6 |      49 |      55
  7 - 9             |    10.9 |    89.1 |    30.9
                    |    28.6 |    31.2 |
                    |     3.4 |    27.5 |
                    +---------+---------+
                  4 |      11 |      64 |      75
  10 or More        |    14.7 |    85.3 |    42.1
                    |    52.4 |    40.8 |
                    |     6.2 |    36.0 |
                    +---------+---------+
             COLUMN        21       157       178
              TOTAL      11.8      88.2     100.0

 CHI-SQUARE    D.F.      SIGNIFICANCE
 ----------    ----      ------------

   1.02036       3          0.8086

   MIN E.F.      CELLS WITH E.F.< 5
   --------      ------------------

     0.944     2 OF     8 ( 25.0%)
```

	The total sample of the study area	E.Kordofan sample	E.Darfur sample
Farm advantage	see below	see below	see below

The total sample of the study area

```
                  RECENT
           COUNT |
         ROW PCT |Yes        No          ROW
         COL PCT |                       TOTAL
         TOT PCT |         1|        2|
FARADVAN --------+----------+---------+
               1 |      104 |      276 |    380
 Land Available  |     27.4 |     72.6 |   85.6
                 |     92.9 |     83.1 |
                 |     23.4 |     62.2 |
                 +----------+----------+
               2 |        8 |       56 |     64
 Land Fertile    |     12.5 |     87.5 |   14.4
                 |      7.1 |     16.9 |
                 |      1.8 |     12.6 |
                 +----------+----------+
          COLUMN        112        332      444
           TOTAL       25.2       74.8    100.0

CHI-SQUARE     D.F.        SIGNIFICANCE
----------     ----        ------------

  5.65571        1            0.0174
  6.41877        1            0.0113
   MIN E.F.        CELLS WITH E.F.< 5
   --------        ------------------

    16.144            NONE
 ( BEFORE YATES CORRECTION )
```

E.Kordofan sample

```
                  RECENT
           COUNT |
         ROW PCT |Yes        No          ROW
         COL PCT |                       TOTAL
         TOT PCT |         1|        2|
FARADVAN --------+----------+---------+
               1 |       91 |      170 |    261
 Land Available  |     34.9 |     65.1 |   98.1
                 |    100.0 |     97.1 |
                 |     34.2 |     63.9 |
                 +----------+----------+
               2 |          |        5 |      5
 Land Fertile    |          |    100.0 |    1.9
                 |          |      2.9 |
                 |          |      1.9 |
                 +----------+----------+
          COLUMN         91        175      266
           TOTAL       34.2       65.8    100.0

CHI-SQUARE     D.F.        SIGNIFICANCE
----------     ----        ------------

  1.32710        1            0.2492
  2.64881        1            0.1036
   MIN E.F.        CELLS WITH E.F.< 5
   --------        ------------------

     1.711      2 OF    4 ( 50.0%)
 ( BEFORE YATES CORRECTION )
```

E.Darfur sample

```
                  RECENT
           COUNT |
         ROW PCT |Yes        No          RO
         COL PCT |                       TOT
         TOT PCT |         1|        2|
FARADVAN --------+----------+---------+
               1 |       13 |      106 |      1
 Land Available  |     10.9 |     89.1 |     66
                 |     61.9 |     67.5 |
                 |      7.3 |     59.6 |
                 +----------+----------+
               2 |        8 |       51 |
 Land Fertile    |     13.6 |     86.4 |     33
                 |     38.1 |     32.5 |
                 |      4.5 |     28.7 |
                 +----------+----------+
          COLUMN         21        157        1
           TOTAL       11.8       88.2      100

CHI-SQUARE     D.F.        SIGNIFICANCE
----------     ----        ------------

  0.07087        1            0.7901
  0.26216        1            0.6079
   MIN E.F.        CELLS WITH E.F.< 5
   --------        ------------------

     6.961            NONE
 ( BEFORE YATES CORRECTION )
```